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Improving Power Distribution Company Operations to Accelerate Power Sector Reform

March 9, 2005
This publication was produced for review by the United States Agency for International Development. It was prepared by PA Government Services Inc.

The following document was prepared by PA Government Services Inc. (http://www.paconsulting.com).

This handbook is the culmination of the cumulative vision of the staff at USAID seeking to help emerging market utility managers overcome chronic impasses in distribution sector development. Gordon Weynand was the overall contract manager for USAID with project management led by Todd Harding. We greatly appreciate the critical input provided by Gordon Weynand, Davida Wood and Ellen Dragotto and others at USAID missions across the globe.

PA Government Services Inc., Washington, DC, a subsidiary of PA Consulting Group, prepared this report, drawing on its consultants experience garnered from innovative and far-reaching development work in the electricity sectors of over 150 countries across the past 30 years. Amit Dalal, Mike Ellis, Grant Hauber, Carl Hocevar, Dr. Krisha Rao (from Global Energy Consulting Engineers, India) and, Tom Smith co-authored this book. The team received invaluable research support and input from PA's staff worldwide, with special thanks to Jairo Gutierrez and Michael Hajny. The handbook was edited by Amit Dalal and Grant Hauber with support from Walter Weaver and Jeremy Works. Amit Dalal was project manager and David Keith was the partner in charge of this undertaking.

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CONTENTS

Foreword

Many emerging market distribution utilities are in a state of chronic disrepair, both technically and fiscally. After an initial surge of interest in the 1990's, there has been a near complete disappearance of private investors. In the wake of regional financial crises and the undermining of utility sector investors in their home markets, there is no white knight on the horizon. Private sector investment in the utility sector will not be coming back, certainly not in the amounts of the go-go 1990's, and definitely not in time to assist emerging market utilities meet their currently burgeoning demand. This is a time for 'self-help' – something this handbook attempts to assist.

This handbook is targeted to help emerging market utility managers plan for improving overall operational performance. Given the potentially limitless scope of such a topic, for practicality we have narrowed the discussion to two primary areas 1) organizational and planning frameworks for operational reform and 2) concrete actions utilities can take in four interrelated operational areas.

We must acknowledge that numerous efforts have been made in the past to address the issues that are the focus of this handbook. These efforts have employed some of the best and brightest minds, yet the results have been decidedly mixed; utility sector problems remain entrenched worldwide. This handbook draws upon this rich body of experience and attempts to craft a new approach. At its root is helping utilities to help themselves.

What is covered in the handbook:

- Devising an approach to improve distribution company performance based on project experience in the developing world
- Focus on what the company management can do to design, implement, manage and refine improvement programs
- Operational areas covered in the handbook:
  - Network balances
  - Metering
  - Customer information systems /Billing and collections
  - Improving cash collections

What is not covered:

- Power sector reform programming at the legislative and regulatory level
- Tariff redesign
- Optimal power sector structure
- Policy guidance to Power Ministry or Regulatory Commissions
- Ownership issues
- Incentive plans for management
- Vendors
- Sample bid documents

We acknowledge that most of these legal, regulatory, and tariff issues are very important, if not equally so to the actual operations improvements. Indeed, without enabling policy, legislation, and regulation ***and*** the will to enforce change, the utility's ability to institute operational improvements is greatly diminished. Chapter IV of the handbook outlines our recommendations for complementary institutional support.

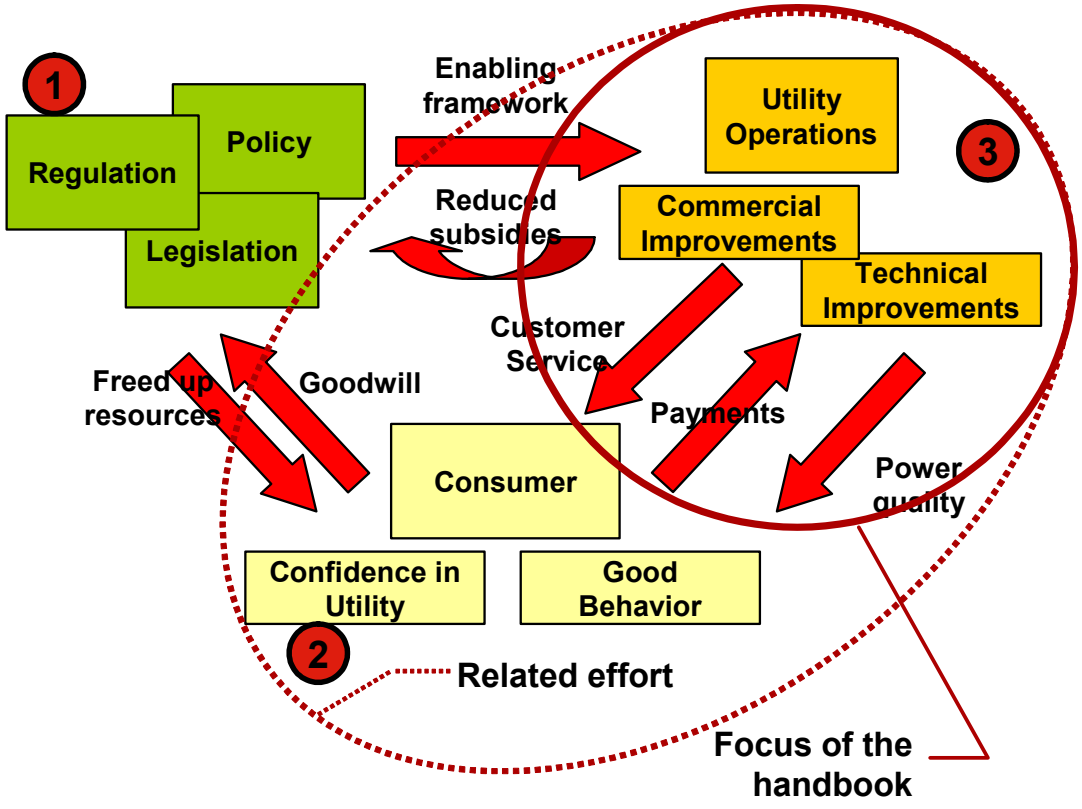
Executive Summary

USAID has prepared this handbook in order to share decades of distribution sector reform experience with governments and utilities seeking to improve their operations performance. The handbook is intended for senior management of utilities in emerging markets that seek to reduce or eliminate chronic difficulties in efficiently, economically, and reliably serving customer demand without heavy reliance on subsidies and emergency interventions. Through case studies, we highlight successful and promising approaches implemented by utilities around the developing world.

There are three primary areas where improvements can be made in the utility sector:

- Policy and legal
- Consumer behavior
- Utility operations

This handbook focuses on the third element, *operational* improvements within a utility, as a catalyst for reform. From a technical and customer service perspective, improved utility operations will go a long way to addressing chronic distrust amongst consumer groups. At the same time it will begin to alleviate the burden on government resources by increasing fiscal performance. Policy, while plotting a bold course of reform, should also pragmatically reflect and be guided by operational realities at the utility level.



The goal of this handbook is to help enhance the utility's core business - operations. It is important to get the commercial foundation built and reinforced and to use that strength to then systematically tackle pandemic challenges.

There are five key principles we recommend to guide planning for improvement:

- **The primary source of money flow into the power sector should be from collections.** The best way to improve operations is to get more cash into the system from customers. Whether or not tariff covers costs, the principle of payment for service must become habitual; it is the only hope for increasing tariffs in the future. In the event of a shortfall in consumer revenue, there are few alternatives: government subsidies, chronic indebtedness, or bankruptcy.
- **Ownership is not an issue for achieving improving commercial performance.** Whether a utility is privatizing or commercializing while still under state control, operational improvement requires the same steps – the difference exists only in where you stop the process.
- **Customer service and financial health go hand in hand.** There is a mutually reinforcing, symbiotic relationship between improved customer service and improved financial health: willingness to pay on the customer side and willingness to serve on the utility side.
- **A program of incremental change is the key to success.** Success breeds success. By setting realistic goals and starting with simple projects, the utility can progress to more complex undertakings all while gaining both internal and stakeholder confidence in the utility's process and enjoying tangible progress.
- **Management must lead change and be accountable for outcomes**. Line staff cannot be expected to develop, resource or management a change program – this responsibility sits squarely with executive utility management.

The handbook first sets the required policy context needed to support operational reform. We review both reinforcing and debilitating policy elements in order to provide a reference against which to diagnose your utility's operating environment. While actual policy design and recommendations are beyond the scope of this paper, the principles are important enablers for enacting operational reforms.

The handbook continues with a holistic, programmatic, and hierarchical approach to operations improvement, with suggested utility management approaches for implementing internal reforms in manner that increases the chance for success during both planning and implementation. We have found that a structured, step-wise, regimented, strictly managed and monitored approach to operational improvement is critical to achieving goals.

We then explore actual operational improvements in detail. Each of these elements focuses on critical aspects impacting the commercial operation of a utility: energy balances, metering, billing management information systems, and cash collection efficiency. Each topic is addressed in detail, providing an introduction to the concept, its role in a utility, how to design and implement the process, and lessons learned from real-life experiences in emerging markets worldwide.

HISTORICAL CONTEXT AND POLICY REQUIREMENTS

Distribution utility operations create the economic base for the power sector. The economic foundation of the entire power sector value chain springs from consumer tariff collections. It is consumers who inject funds into the utility system, whether directly through tariff payments or indirectly via tax collections that re-emerge from the government in the form of subsidies. These monies are the lifeblood of the utility sector that pay for fuel, salaries, operations, maintenance, and potentially even capital investment for generation, transmission and distribution. But currently, many utilities in developing countries do not meet their cost of service, let alone the needs for new investment. Fixing, or in certain cases, developing from scratch the commercial operating foundation of the distribution segment is now the top priority to achieve economic sustainability in the power sector. However, revitalizing the sector requires significantly changing the way utilities operate, overhauling regulations and isolating it from political interference. Equally important, utilities must change their often adversarial relationship with customers. Eliminating the mutual angst can potentially remove the logjam that prevents reliable customer service and dependable consumer payments.

Change is difficult and unpopular — anywhere, at any time, in any industry. Change in the power distribution sector is particularly painful; the sector is a large employer, it is subject to societal biases about tariffs, and increasing investments is particularly challenging. But those who embrace constructive change in the power sector have yet another opportunity to make a tangible and measurable improvement in the lives of millions by providing affordable and reliable electricity, supporting economic development, and freeing up the huge sums now spent on subsidies so they can be applied to better social purposes.

Demand is growing once again; the time for reform is now. Globally, we see electricity demand growth returning to historical averages, and in many cases growing at rates faster than economic growth. Policy makers in developing countries, while still focused on increasing overall sector investment, need to turn their focus on improving commercial delivery and performance of entities by addressing fundamental managerial and operational weaknesses. One area receiving intense scrutiny and investment is the operational aspect of the power distribution network's "last mile" – the most visible portion of the electricity industry. Here, the taxonomy of distribution companies spans the entire ownership spectrum – from a government department to a fully privatized entity operating within a transparent regulatory regime. Most developing countries hope to transition to ever more modern and organized "corporate entities" with improved commercial performance as the primary objective. The reality is that this process is bogged down by a variety of forces – political, economic, consumer behavior, and rigidity on tariffs to name a few. The result is that distribution companies are left providing a low quality commodity to an irate consumer group.

Privatization is not a prerequisite for reform. Operational reforms can be equally applied to corporatized state-owned utilities as they can be to privatized utilities. Privatization is not a prerequisite for reform. However, improving performance at a state-owned organization is not easy; it requires the will of the government and commercially-minded executive management at the utility. The utility must be set on a path to commercially-oriented operations. The processes described in this handbook are tools that can be used to affect commercial change, but they will not create it. This impetus must come from the top, both from government and from utility management.

Based on our experience, we believe that even some of the world's most chronically underperforming utilities can become more commercially sustainable. Utilities can gain tremendously by reducing technical losses, eliminating theft, and following through with billing and dues collection, and improved customer service – operational improvements that we cover in this handbook.

However, operational reforms cannot produce results by decree. Foremost, successful reforms require dedicated, professional managerial expertise and sustained political will. Utility management must have a vision of the business, and pursue an integrated plan to execute, measure, and refine the reforms. Utility management must also be held accountable for achieving results, both penalizing and incentivizing them based on measured results. Politically, government policy makers and legislators need the will to create conditions for reform success, and leave those measures in place.

The acid test is accomplishing those ends while creating bankable companies — companies that are capable of borrowing funds at market rates from non-government banks on commercial terms and without government guarantees[1]. This will require the utility to consistently achieve good cash flow and earnings in addition to high quality service at competitive prices. There is no reason for utilities, even those still owned by the government, to be forever tied to state sector finances.

Achieving these goals is a worthy, if somewhat daunting, challenge.

Institutional support enables and sustains reform. To succeed, the operational improvement process requires support from the government and regulator. Without the enabling policy, legal, and regulatory support, and the will to enforce change, the utility's ability to institute operational reform is greatly diminished. There are number of areas from which this support can come:

- ***Political support.*** Government must maintain its will to see a commercially self-sufficient power sector. In this sense, government should refrain from using the power sector as a political tool for currying favor from certain constituencies. De-politicizing power is the best way to achieve this. If subsidies are a necessity, grant disbursements should be transparent but outside the utility's operating environment.
- ***Legislative support.*** The government can go a long way to create enabling conditions for reform. First, it can de-politicize electricity by ceding day-to-day oversight to an independent regulator. It can assure utilities have the right to collect monies from customers for services rendered by criminalizing theft of power and authorizing the utility to disconnect delinquent customers.
- ***Regulatory support.*** The regulator can play a critical supporting and custodial role by creating a stable, predictable environment in which operational reform can take place. The regulator strikes a balance between utility, government and customer by creating commercially oriented tariff policy, monitoring utility customer service performance, and auditing utility finances

Operations improvement extends to customer relations. The utility should recognize that its cash flow problems may have as much to do with its own performance as with consumer

[1] Presumes that businesses in a given country have access to a healthy domestic commercial finance sector or, lacking a robust domestic banking market, have access, in general, to global capital markets.

intransigence. People dislike paying for a service unless they believe it has value and meets their needs and expectations. Similarly, a utility only wants to serve customers that value their service by paying for it. In chronically underperforming utility environments, we find that utility staff and its customers are effectively at war with one another. Although difficult, as the service provider, the utility must be proactive in reaching out to its public, soliciting its input (and often, weathering its pent up frustration), and describing the actions that will be taken, and how they will benefit both the utility and the consumer.

While currently in an experimental stage, the use of grass roots, community level utility advocates for rural agricultural and residential customers holds the potential for yielding mutually beneficial improvements in customer service and consumer payment performance. Utility reforms often leave these consumer segments behind because they are seen as low value and high cost to serve. But, left unchecked, they can be a primary source of massive losses, both technical and fiscal. Having a trusted intermediary that is trained in utility policies and procedures can solve minor service problems in the field; this person can also act as a liaison between the utility and customers, and help forge a positive bridge across the relationship gap.

Four Axioms of Reform. PA Government Services Inc. (PA) believes that the essence of power sector reform is to unshackle the industry from the past and enable electricity providers to become efficient enterprises — be they privatized corporations, rural cooperatives or others — and provide high quality service at competitive prices.

PA developed the procedures and recommendations in this handbook based on its four axioms of reform, derived from PA's extensive experience in dealing with emerging market utility sector reform over the past thirty years.

- **Accountability is the basis for reform.** Accountability is the result of authorizing a person or entity to take certain actions, establishing a target against which the success of those actions may be measured, measuring that performance, and rewarding or sanctioning the person or entity based on performance against target.
- **Ownership for reform must be built through participation.** The government and utility must generate the impetus for reform. Outside help can facilitate change, but the leadership for change must come from within. The utility and government must believe in the process of change, own it and internalize it in order to make reform work.
- **Reform requires a holistic approach.** Reform success depends in part on creating and motivating institutions to fulfill their roles in a restructured sectoral environment. The approach to reform should encompass technical content, processes and people to produce results. Targeting one aspect of operations without considering how that element interacts with or influences the balance of the sector can lead to ineffective, suboptimal or even destructive results.
- **Reform must enhance social development and equity.** A reform program must continually justify itself in terms of social benefits achieved, and ensure that these results are conveyed clearly to public.

Operational Improvements Covered in this Handbook

The elements of operational improvement that this manual addresses are:

- **System energy balances.** Chapter V discusses the fundamentals about network energy balance, which measures the difference between the energy input into the system and the energy received by the customer. This enables a utility to account for all energy used, sold, and lost or stolen in distribution. With such information, a distribution company can assess its efficiency, and consider investments to reduce energy losses. The chapter discusses types of utility energy balances, methodologies to implement them, as well as case studies illustrating their purpose and value.
- **Expanded metering**. In Chapter VI, we present the critical element of electricity metering, and the role that it plays in power sector reform. As the utility's product, a commercially viable utility must accurately account for power inflows and outflows within the distribution network and to customers. This chapter introduces metering concepts and programs, and outlines key factors for success in metering, including accountability, quality data management, computer system integration, and an enabling institutional and regulatory environment. We also present case studies and lessons learned from various metering experiences.
- **Upgraded management information systems**. We dedicate Chapter VII to Management Information Systems (MIS), since proper data management is an essential component for corporate decision-making. While a single, integrated MIS is one option for comprehensive management functions, many utilities in developing countries can more readily adapt "best of breed" applications selectively based on specific needs and budgetary constraints. This chapter assists utility managers to identify appropriate options for the right mix of system capabilities.
- **Improved cash collection efficiency.** Finally, Chapter VIII deals with the sensitive but critically important issue of cash collection. No commercial enterprise can operate viably without successfully collecting payment from customers. Since distribution companies generally operate on a thin margin, non-paying customers reduce cash flow, making it difficult for the distribution company to pay suppliers. Developing countries face challenging in collecting payment for many reasons. This chapter highlights strategies to address many of these challenges – including technical and managerial (such as linking metering and billing data), cultural (historic non-payment for electricity), political (corruption or government interference), among others. All solutions rely on solid management, with tools such as capacity building, communications, and outreach with staff and all stakeholders.

Recommendations for success

When applying the detailed operational improvements described in this handbook, there are several critical, recommended ingredients for success in this uniquely challenging corporatizing, commercializing environment. These are:

Management

- **The utility CEO must lead operational reform, taking a holistic view of the process.** Performance improvement should be the utility CEO's number one priority. Only the CEO has the breadth of vision and the depth of influence to make the most difficult and far-reaching reforms happen. Senior management vision, guidance and monitoring are

required to see the greater performance improvement program come to fruition; it is too important to delegate to line management.

- **Take a programmatic approach to improving power distribution.** The single biggest mistake distribution companies make is to embark on programs in a piece-meal fashion, often not tying a particular operations improvement project or investment to a broader corporate program of commercial performance improvements. To avoid this, executive management must properly define the program.

Planning

- **Systematic and strategic implementation of operational reforms promotes success.** The utility should carefully plan implementation of operational improvement projects to initially focus on areas where the utility can reap the largest savings over the shortest period of time with the least investment. Choosing the initial service territory and customer classes to be targeted can impact the success of the program by delivering quick, high profile, high value wins. This success breeds confidence from stakeholders – customers, government, even utility staff – that allows reforms to develop their own momentum. For example, a utility should target higher density urban areas first since a larger number of customers can be impacted. Also, utilities should start with large industrial consumers prior to addressing the more numerous residential classes as they are fewer and usually higher value clients.
- **Focus on basic functions first, then increase sophistication.** Many of the most successful performance improvements initially come from low-tech solutions. For example, a utility can have the most advanced IT system for billing in the world, but this tool is meaningless without actual collection of money. Restructuring business processes, redefining how current employees do their work, and enforcing policies currently in place often yields great improvement. These processes can later be improved through automation.
- **Set realistic goals for performance improvement** over a reasonable time period. Under-promising and over-delivering is far better for building staff morale, creating public trust, and drawing government support than the opposite. Be very realistic about your ability to secure the changes you set out achieve.
- **Accurately assess the current condition of the distribution company's regulatory environment to determine what is possible.** The sector structure in which a distribution utility operates has a major impact on how it is able to conduct its operations. The greater the level of independence utility management has from government influence, the broader the opportunity is to affect improvements. Understanding the boundaries of what is possible under the current regulatory environment permits better planning of short-term improvement programs and will help to identify which areas utility management should work with regulators and legislators to help enable the next phase of reforms.

Measurement

- **Understand where losses occur in your system; data is important**. As Francis Bacon once said, knowledge is power, and in the case of a distribution system, this can be taken literally. Before embarking on a reform program, performing energy balance analyses – measuring and monitoring purchased, delivered and billed power on the system – is imperative. This will allow utility management to understand whether losses are technical or commercial in nature and permit them to identify which physical portions of their grid require the greatest attention.

- **Clearly define current conditions**. As part of understanding of the system, the utility must establish a baseline. This facilitates stakeholder understanding regarding the state of the utility as it embarks on its operational reform. It will also permit the utility to clearly illustrate its achievements from the reform.
- **Measure Success.** It is important to establish clear metrics, or Key Performance Indicators (KPIs), that track the progress from the 'as-is' condition prior to the start of reforms through the course of operational improvement. They also allow the utility to set improvement targets over time. KPIs provide transparent, defensible proof regarding results from reforms, and pinpoint where and how they are working (or not). Management must continuously measure, monitor and report progress to stakeholders – including customers. Utilities can define KPIs per an internal operating standard, by international standards, or a mix, as is appropriate and realistic for the utility.

Financing

- **Pool available capital resources to support reforms: a utility Finance Director's priority.** The finance director should coordinate funding to support operational improvements. There are many sources of funds available from multilateral, bilateral, commercial and private entities. The finance director may pool these resources and manage them like a portfolio in order to optimize against investment needs. The finance director must also closely monitor and manage performance post-implementation in order to satisfy the reporting requirements of lenders and investors. This promotes good governance, keeps investors happy, and provides good publicity within the investment community for the next time the utility needs capital.
- **Assure adequate funding is available.** Be realistic in estimating the cost, effort and time involved to achieve reforms. If funds run out in the middle of the improvement process, waiting for approval of support funds or raising new funds from external sources will create gaps in the project timeline, cause reforms to lose momentum, and may even reverse progress or kill the project altogether.
- **Using savings to pay for additional reforms.** Savings generated from improvement programs can sometimes be viewed as a windfall for the utility. Utilities should exercise restraint and discipline by earmarking those savings to either help fund additional improvements or repay loans taken to fund the initial project.

Execution

- **Use low cost, off-the-shelf technology, equipment and systems.** There is a tendency to want the very best technology and equipment, and customized systems, but often these are simply not practical or affordable for the intended applications. For example, sophisticated revenue KWh meters can run into hundreds, and even thousands, of US Dollars per meter; while low-cost non-revenue meters can be well under twenty US Dollars per meter. The company needs to look at what features, and degree of accuracy, is really necessary and cost justifiable. The same is particularly true with computer based MIS, billing and collection, and data acquisition systems. Most utilities in developing countries could benefit greatly by utilizing off-the-shelf computer systems. Often, the most basic and practical operations improvements will achieve the greatest benefit. If a distribution company can achieve 100% metered consumption, for example, the degree of accuracy and efficiency of data acquisition may be secondary, at least initially. Once a base of metering is established, the utility can make additional improvements over time and as financial condition permit.

- **Communicate with stakeholders – before, during and after improvements.** There is often misunderstanding of how the reforms will take place and what the implications are for stakeholders. Utilities must communicate clearly with the public – who may feel they will bear nothing but increased costs – the utility workers – who may feel they will lose their jobs – and the government – that may believe it will experience constituency revolt. Clearly laying out the purpose, scope and benefits of proposed reforms clarifies their purpose; regular updates, drawing upon KPIs, keeps stakeholders informed of progress.
- **Use functional outsourcing and contracting to help extend capital and resources.** At times the utility cannot undertake improvements completely on its own; sometimes it requires outside help. Use of management outsourcing contracts, franchising operating areas to private entrepreneurs, and even 'microprivatizing' defined portions of the grid can help utilities to speed commercial improvements by improving collections, reducing non-technical losses and increasing customer service.

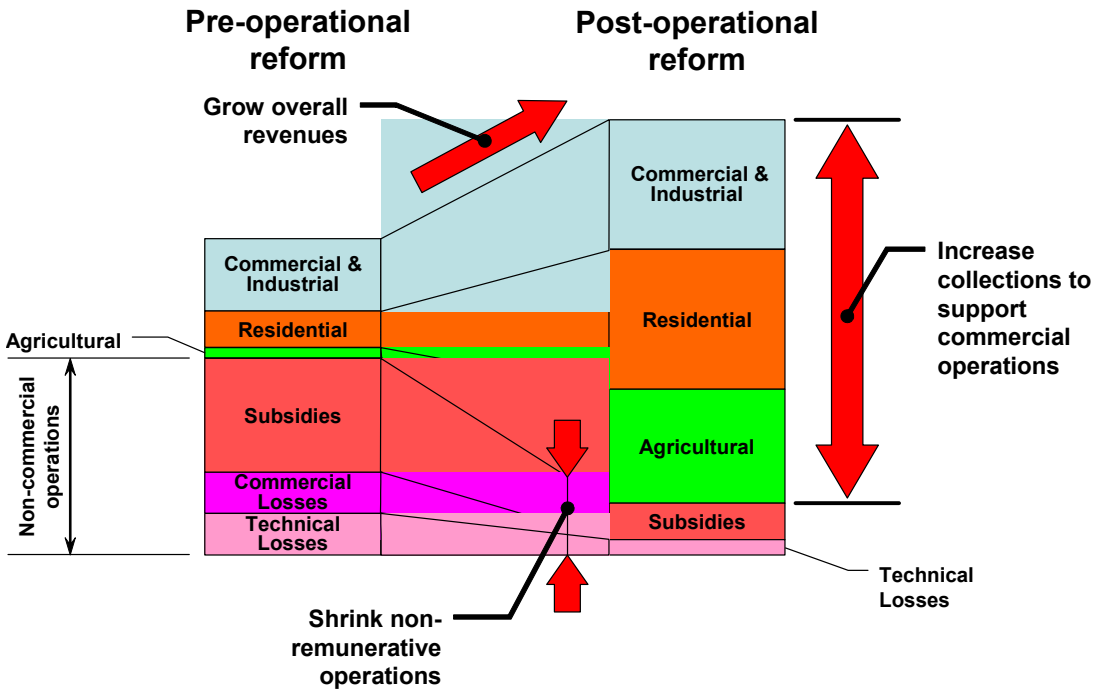
Goals of operational reform

Ultimately, the goals of the operational improvements outlined in this handbook are to:

- Grow revenues
- Shrink all forms of loss
- Reduce the need for subsidies
- Minimize the time to realize these savings
- Create the foundation for sustainable commercial operations

These goals are shown graphically below. Utilities must minimize all forms of non-commercial operations – technical and commercial losses, subsidies -- while increasing collections and adjusting tariffs to levels that reflect, at minimum, the cost of service.

Goals of the Operational Reform Process



USAID has played an important role in improving the power distribution function in many developing countries through policy and regulatory assistance, training and large-scale equipment procurement. This experience spans geographies, organizational cultures and levels of corporate maturity and sophistication. This handbook strives to distill the essence of lessons learned from decades of development experience throughout the world.

List of Acronyms

ABACUS	Armenian Billing and Collection Utility System
ADB	Asian Development Bank
AMR	Automatic Meter Reading
APERC	Andhra Pradesh Electric Regulatory Commission
APSEB	Andhra Pradesh State Electricity Board
CEO	Chief Executive Officer
CIS	Customer Information System
COA	Chart of Accounts
CRM	Customer Relationship Management
DFID	Department for International Development
DOS	Disk Operating System
DSEDN	Darkhan Selenge Electric Distribution Network
DSO	Day's Sales Outstanding
DSS	Decision Support System
EAI	Enterprise Application Integration
EAM	Enterprise Asset Management
EBRD	European Bank for Reconstruction and Development
EES	Eastern Energy System
ERP	Enterprise Resource Planning
ESCOM	Electricity Supply Company of Malawi
FSU	Former Soviet Union
GDP	Gross Domestic Product
GESI	Georgia Energy Security Initiative
GIS	Geographic Information System
GOG	Government of Georgia
GPS	Global Positioning System
GWEM	Georgia Wholesale Energy Market
HQ	Headquarters
IAS	International Accounting Standards
IFC	International Finance Corporation
IFMIS	Integrated Financial Management Information Systems
IMF	International Monetary Fund

IT	Information Technology
KPI	Key Performance Indicator
KPM	Key Performance Measures
LAN	Local Area Network
MB&C	Metering, Billing and Collection
MIS	Management Information System
MUPS	Municipal and Utility Package Software
OECD	Organization for Economic Cooperation and Development
PC	Personal Computer
SBD	Standard Bidding Document
UDC	United Distribution Company
USAID	United States Agency for International Development
WAN	Wide Area Network
WB	World Bank

I. Description of this Handbook

This handbook addresses areas where utilities located in emerging markets can take the initiative – whether they are contemplating restructuring, in a post-corporatized phase or have been fully privatized – to garner substantial gains in commercial performance through targeted operational improvements. Globally, we see electricity demand growth resuming its increase, and the factors that created the first global rush for power sector investment appearing once again. Therefore, we feel that now is a propitious moment to improve distribution company commercial performance. In the wake of the major financial crises that impacted Latin America and Asia, in concert with the crisis of confidence in the power sectors in the US and UK, it is imperative that this time around the distribution sector prepare itself to support the next growth cycle, whether it is privatized or is a customer to private power generation.

We draw on the experience of utilities in developing markets worldwide to demonstrate how the principles in this handbook have been successfully applied. While utilities can realize operational improvement through numerous means, this handbook focuses on four areas where substantial gains can be made:

- System energy balances
- Metering
- Billing programs and systems architecture (including customer information systems)
- Cash collection

We support each topic with practical examples illustrating how change was affected to yield positive benefits for the utility. In some cases, positive benefits were not achieved and, therefore, we highlight lessons learned.

There is no universal panacea for achieving commercial success. Efforts must be made at all levels of government, utilities, and indeed, among customers, in order to yield a long-term, viable operating system. However, in addition to the technical and commercial fixes that are the primary focus of this handbook, having an established and accepted legislative and policy structure is important in order to create a framework within which the utilities can operate. This enabling environment is an important contributor to the success of the programs proposed herein. Indeed the ability to undertake the programs described in this handbook is premised on the assumption that a) the enabling legislation is in place for commercially-oriented utility reforms; and b) government actors actually want the utility to undertake the reform program and succeed. In many markets, these two elements are not guaranteed. However, without such support, operational reforms are likely to be doomed to failure.

Chapter II of this handbook provides context to the current ‘commercializing’ distribution sector environment, elaborates on the universe of problems currently facing utilities in transition, and describes some of the prerequisite policy factors needed to support commercially oriented distribution operations.

Chapter III examines the context in which ‘commercialization’ of a state-owned utility is taking place, whether through privatization or reforms.

Chapter IV provides a programmatic approach to implementing operational reforms. Operational improvements should not take place in isolation, but as part of a holistic program that matches utility, consumer, and regulatory needs with funds and best practice. The approach also recommends a prioritization of actions that first emphasizes high value, easy to implement activities, then graduates to more capital intensive or refined actions.

The remainder – and majority – of the handbook addresses the actual technical and procedural improvements that a distribution utility can undertake in its operations. We have focused on these topics, since they cover areas where a utility can reap large improvements in a step-wise fashion without necessarily having to undertake a massive and disruptive capital improvement program. Each topic is designed to be implemented in manner that progresses from a less costly reorganizing of current resources and business processes through to more far-reaching investments in capital, personnel training, and field implementation.

Chapter V discusses the fundamentals about network energy balance, which measures the difference between the energy input into the system and the energy received by the customer. This enables a utility to account for all energy used, sold, and lost or stolen in distribution. With such information, a distribution company can assess its efficiency, and consider investments to reduce energy losses. The chapter discusses types of utility energy balances, methodologies to implement them, as well as case studies illustrating their purpose and value.

In Chapter VI, we present the critical element of electricity metering, and the role that it plays in power sector reform. As the utility's product, a commercially viable utility must accurately account for power inflows and outflows within the distribution network and to customers. This chapter introduces metering concepts and programs, and outlines key factors for success in metering, including accountability, quality data management, computer system integration, and an enabling institutional and regulatory environment. We also present case studies and lessons learned from various metering experiences.

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Finally, Chapter VIII deals with the sensitive but critically important issue of cash collection. No commercial enterprise can operate viably without successfully collecting payment from customers. Since distribution companies generally operate on a thin margin, non-paying customers reduce cash flow, making it difficult for the distribution company to pay suppliers. Developing countries face challenges in collecting payment for many reasons. This chapter highlights strategies to address many of these challenges – including technical and managerial (such as linking metering and billing data), cultural (historic non-payment for electricity), political (corruption or government interference), among others. All solutions rely on solid management, with tools such as capacity building, communications, and outreach with staff and all stakeholders. Each of the chapters contains practical, real world examples of what the described improvements can achieve.

II. Operational Reform in Context: What Happened, What Can Be Done, and Why

Many developing market distribution companies suffer from huge fiscal deficits, poor power quality, rampant theft and myriad other difficulties. It is often difficult for government politicians, bureaucrats and even utility management to understand how things could get so bad. It does not have to be this way, and with proper organization and the will to succeed, the path to improvement is within reach.

This chapter provides a general historical context of how underperforming distribution companies evolved into their current state, and how they can address these problems. We first discuss the impact of rapid economic growth and global investment on utilities. We then look at the aspects of institutional oversight, utility management, utility operations, and customer service that contribute to the problem. Means to address these problems are introduced with linkages to the detailed approaches outlined in the technical chapters of this handbook. While there are many activities a utility can undertake to improve its operations, the policy and legal environment in which it operates is just as important. This chapter discusses some of the legal and policy prerequisites impacting effective utility reform. This experience, taken together, has contributed to the development of four axioms of reform that we recommend as a guide for any reform or performance improvement program.

Three Generations of Utility Sector Investment

In the history of power sector evolution in the developing world, we are on the verge of a new era of investment. The first generation of investment saw the initiation of power service, undertaken most commonly by state-owned companies whose goal was to provide electricity to the people. As electrification was seen as a symbol of progress and prosperity, it was a key political tool to ensure the support for and continuing popularity of the ruling government – be it local, state/provincial or national. More often than not, access to electricity came to be considered a public right. Expanding service was commonly viewed as more important than the economics of operating the system, or planning for its sustainable growth; such created the foundations of an entrenched subsidized system.

The second generation of investment came as these economies opened and grew. Often, the state apparatus was ill-prepared to cope with the burgeoning demand for electricity. Capital was needed quickly. The doors of the power sector were opened to foreign private investment, and companies rushed in flush with capital. The goal of these investors was to attain returns commensurate with their “pioneer” status, i.e. far higher than those that were available in their stagnant home markets. Utility sectors were reformed to allow private access, but most of the reforms were incomplete. Anxious to take advantage of the influx of capital, governments crafted and closed deals before the fiscal performance of their utilities could be improved. At times, corruption and/or favoritism played a detrimental role in selecting investors and crafting deals, yielding economically or politically unsustainable arrangements. Projects failed, state utility treasuries crumbled, and investors retreated in the wake of the financial crises of the late 1990s.

We are now at the beginning of the third generation of investment. This is the age of increased self-sufficiency. With second-generation investors mostly gone, the partially reformed state

utilities are left alone to cope with their reawakening economies. This time, capital must either be internally generated or internally supported, backed by rational economic operating performance. And the key to achieving this performance is through improving the distribution segment of their systems.

At the outset of private sector involvement in power infrastructure development, the goals were laudable. Private sector investors, given their access to capital, could provide the massive investment needed to boost development of critical infrastructure. Ideally, this investment would displace large segments of state utility and government budgets, freeing up capital for investment in areas of their power systems that were less commercially attractive but in equal need of enhancement and expansion. We all know now the outcome of the story: foreign investors gravitated to large single asset generation opportunities, while leaving transmission and distribution system improvements to the utilities. The capital displacement effect never occurred. The large, hard currency investments from the private sector required such onerous guarantees and high tariffs to support them that they could not contemplate any additional investment on the scale required. Utilities and governments alike were so satisfied with all of the interest from foreign investors and support through government guarantees that they became complacent with their economic state, their fiscal management policies, and the entrenched loss-making regime. With guarantees in place, investors felt insulated from the fiscal malaise that surrounded their plants. We now know that this was a recipe for failure; unless revenues are sufficient to cover operating costs, no guarantee will stand up to the immediate political-economic impact of a crisis, nor will it be sustainable over the longer term. In the wake of the Asian and Latin American crises, we saw two outcomes: large-scale default on payment obligations requiring lender intervention and equity investor write-offs, or, for those countries wanting to uphold their contractual obligations, a current state of siege by foreign investors who own and/or operate a significant amount of generation capacity priced at a premium over world market levels.

Whatever the current state of the system, the root of sustainability starts by reforming the most basic tasks of any company – monitoring sales, billing for commodity sold, and collecting on those bills. If that part of the system is not working, no investment can be expected to survive the test of time. Subsidies and government guarantees are not the answer.

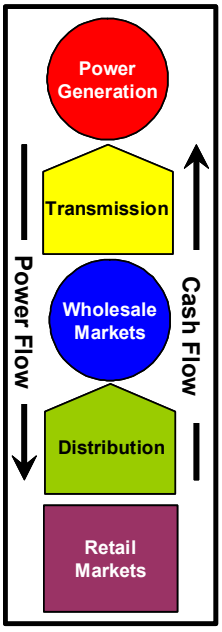
As we enter the third generation of investment, economic improvement of utility operations needs to be squarely in the sights of all players. Utilities must get their books in order to provide a base for sustainable operations, at minimum, and funds for growth, if possible. Governments cannot afford to have their nations both starved for capital and for electricity, either of which holds back economic growth. Distribution companies will be on the front line for fostering economic sustainability as they are at the intersection of consumers, wholesale power production, transmission, and policy. They are the entities that provide the monetary inputs to the system such that all other segments will function. Getting that function correct is the key to success. This paper will present ideas, backed by experience, of how to better get cash flows into the electricity value chain and sustain sector economics over the long term.

Origins of Operational Challenges in Emerging Economy Distribution Companies

Electric power supply, particularly in developing market economies, has been widely viewed as a public right and a public service. In such countries, it has usually fallen to the government to provide these services. Given the nature of this service – essential to business, agriculture and individuals alike – it easily becomes a politically charged topic. Electricity has been used as a tool to both build economies and placate masses. As such, the fiscal health of the utility has often been secondary to the policy goals of the governments that control them. This situation was viewed as internally acceptable when governments had budgetary surpluses and demand growth was minimal. However the last two decades of the twentieth century brought about a sea change in that relationship. Opening doors to global trade and investment sparked great surges in economic development and, in turn, spurred demand for electric power. The social policies of the past could not cope with this unprecedented demand for capital to fuel expansion. Governments, in need of investment and not wanting their countries to fall behind in their competitiveness, opened their state utility sectors to foreign private investment offering an assortment of tax breaks, concessions, and guarantees to secure contracts. Most of this was done before the foundation elements of related legal, regulatory and fiscal policy had been laid for sustainable growth. Such hastily crafted policies left utilities fiscally overcommitted, in chronic deficit, and eroded quality of service.

After examination of each national power policy failure there is one key economic equation that has proved its validity many times over: monetary collections must at least equal cash outflows. This is true whether a utility is vertically integrated or has been unbundled into its constituent components. Despite the simplicity of this basic financial principle, sector participants in the 1990's – whether investors, utilities or governments – clearly needed to be reminded that they could not turn lead into gold. Long before the Internet Bubble of 2000-2001, power sector players displayed US Federal Reserve Chairman Alan Greenspan's often cited "irrational exuberance" by crafting deals that relied on promises and faith rather than sound financial fundamentals. The rush to tap seemingly endless reserves of foreign investment capital on the government side, and a perceived shortage of deals on the investor side, led all players into relationships that violated the principles of sustainability, and, when put to the test under the strain of economic crises, ultimately failed.

Figure 2-1
The Electricity Value Chain



Now, the foreign investors have for the most part retreated to their home markets and are licking their wounds. We are in a time where it may take years before such investors return. If or when they do, it will likely be with much more stringent, fundamental assessment criteria. During this investment liquidity crunch is the time for distribution utilities to step forward with operational reform programs that create the fiscal foundations to support the next wave of investment. And whether such investment comes from foreign, regional or domestic capital sources, it is certain that all investors will be closely examining the cash flow of the entire power value chain (Figure 2-1) to make certain there is a sound investment climate.

Given this important lesson learned from the first wave of private investment in the state-owned energy sector, it becomes clear that distribution companies will play a major role in determining whether or not the power sector will grow sustainably, or will be mired in debt and disrepair. No

one will risk capital for the long periods such investment requires without adequate assurance that this money will eventually be recovered. The measure of investment efficacy will come not from government or corporate guarantees, but from whether or not sector participants have a demonstrated track record of generating an operating profit. And the front line for cash inflows to the electricity value chain is distribution company collections from the customer.

Distribution utilities in emerging markets face myriad challenges covering a broad range of areas – socio-economic issues, chronic underinvestment, poor collections, and non-commercial tariff regimes. The typical characteristics of developing market distribution companies in a pre-reform stage are listed in Box 2-1. These challenges and their implications are elaborated in the sections that follow. They can serve as a diagnostic guide for utilities and governments planning their operational change programs.

Box 2-1 – Characteristics of Poorly Performing Distribution Utilities in Developing Countries

Tariffs, Subsidies

- Entrenched subsidies for residential and agricultural consumers
- Subsidies used by the utility as a 'catch-all' to make up for inefficient operations
- Reliance on large cross-subsidies provided by industrial and commercial customers

Billing and Collections

- Large levels of customers arrears and/or unbilled accounts
- Inaccurate bills, irregular billing, unregistered customers
- Engrained idea that electricity is a public right, fostering a culture of pilferage.

Customer Service

- Little or no focus on customer service or the quality of that service
- Little or no communication with the public
- Difficult for customers to pay bills or communicate effectively with the utility

Staffing

- Utility used as policy employment vehicle causing bloated costs and inefficient performance
- Significant overstaffing yet lack of performance objectives and measurement criteria to gauge effectiveness and optimize staffing complements

Institutional Problems

- Lack of political will to enforce laws or change practices in dealing with the power sector in order to sustain political goodwill
- Corruption at the government level and within the utilities
- In general, the lack of a business management focus

Operating Issues

- High technical and commercial losses with few targeted plans for addressing them
- Lack of understanding of the cost drivers embedded in the current system, both technically and economically
- The customer classes that cause most technical and economic difficulty are either the ones that are least remunerative (e.g. small-scale agricultural consumers) or are the "sacred cows" of the economy (large State-owned industry)

Tariffs, subsidies and the socio-economic challenge

One of the greatest challenges facing reforming distribution companies is dealing with the often incompatible requirements of providing a public service for the common good while trying to recover all the costs of providing service, including a return on investment. In many countries, agricultural and residential tariffs are greatly subsidized, both indirectly by other consumer segments, and directly though grants from the government. Often such subsidies do not cover the entire cost of service deficit. In certain countries, electric power supply is legally defined as a public service and not as a commodity product. This has made transition to an unbundled, restructured, profit making business politically contentious and difficult.

Further complicating matters is the consumer's view of power as a public right, whether legitimately provided for free, highly subsidized, or pilfered. The key to success is adoption of a gradual transition to a commercial environment. Permitting theft to exist creates a slippery slope where, if left unchecked, can see the economic viability of the utility collapse. Providing free or near-free power sends the wrong signal to consumers, encouraging wastage and misuse of electricity.

The ability of utilities to raise tariffs to economic levels is severely limited by a number of factors: political interference, biased regulatory oversight, and economic reality. These factors are interrelated. For the poorest consumer classes, under current conditions, it is almost impossible to pay the full cost of power. Large tariff increases would likely spur widespread unrest. Enforcing massive curtailments of pilfered supply would likely take the effort of police or other such armed authorities. In fact, a culture of pilferage or entitlement is deeply rooted in many societies and cuts across all sectors of the economy. Attempting to single out the power sector to promote cultural reform is most certainly doomed to failure and resistance by the population at large. Instead, a go-slow approach is probably the only acceptable course of action. Politicians and regulators alike are prone to favor small, incremental adjustments in tariff and operating practices that can ease the transition to a utility's economic stability. However the period over which such entities view increases taking place is far too long for a commercial utility attempting to meet its operating expenses in time to prevent a financial collapse. But often what is needed is a "big bang", or complete overhaul of the distribution sector (See Box 2-2).

Box 2-2 – The rebirth of New Delhi distribution

In New Delhi, India, demand growth skyrocketed in conjunction with a burgeoning population. Pilferage of power became accepted and corruption within utility service became practically institutionalized. Quality of service was very poor with low voltage, frequency and outages a daily occurrence. During the peak demand season, some areas of the city could be without power for 22 hours per day, leaving many homes without the ability to pump water for cooking and cleaning. The combination of technical and commercial losses within the city exceeded, by one estimate, 60% of all power delivered to the grid. In desperation, the New Delhi Government voted to privatize the distribution of power in order to stop what appeared to be a situation where fiscal hemorrhaging would continue unchecked. As part of the privatization process, a realistic approach was adopted governing what a private entity could achieve in performance improvement over a defined timeframe. Existing losses were baselined and a gradual program of improvement proposed over a period of years. The regulator determined that the combined level of technical and commercial losses at the inception point of the concession was between 48%-55%, depending on the service territory. Concessionaires were required to reduce those losses over a period of 5 years to 31%-35%, after which point a new improvement program would be agreed. In July 2002, three distribution circles were successfully auctioned off. Initial indications are that the privatization program in New Delhi has begun to stem the losses to below 40% as of this writing (about one year ahead of agreed improvement levels) after a concerted campaign to reduce theft of power, improve billing and collections, and upgrade badly deteriorated distribution assets.

In the short run in most developing markets, raising tariffs to economic rates is not an option. The cost of power as a percentage of income would rise to such levels as to make electricity unaffordable. In countries with struggling State-owned enterprises, raising industrial tariffs or enforcing collections of chronic past dues could sound the death knell for these businesses.

While obsolescence may be an inevitable outcome for such industries, electric sector reform would then need to be coordinated with broader restructuring of the State-owned sector. Politically it is untenable to propose transition to a regime where fewer people or businesses than before have the ability to afford or have access to power. The potential for social unrest would run extremely high.

Figure 2-1 – Extent of Subsidy for Select Utilities

Country	Utility	Cross-Subsidy	Direct Subsidy	Deficit (US$MM)
		US$ million-equivalent		
India	APCPDCL	~10.0	10.5	400
Mexico	CFE	Negligible	1,800	1,100 surplus

Notes:

APCPDCL – 2002-2003 tariff. Subsidy based on revenue requirement; poor collections led to the large operating cash deficit

CFE was permitted to keep its 'profits' in order to reinvest in system expansion[2]

However, there are ways to reduce the economic losses and encourage more efficient electricity use, as we will see through some of the case studies later in this paper. Elimination of theft, improvement in billing and collections, settlement of arrears and accounts receivable, demand side management, and technical system improvements are just a few of the ways to improve commercial performance.

Need for regulatory support

One of the myths associated with privatization is that control of the utility sector is completely transferred to the private sector. In no country is the power sector completely free from government control. Most utilities are governed by rules that cover the rate that can be charged for the service, quality and scope of service that should be provided, environmental and safety requirements, etc. A key part of the utility reform process that typically should precede or happen concurrently is the establishment of an independent body to regulate the power sector. The regulator has transferred to it the legal authority to make binding decisions on customers and the utility.

States that formerly controlled the long-term operational destiny of the power sector need to transfer planning and management to the utility. This does not mean that a government should abdicate its role in energy sector policy or energy security. But issues such as where and when investments are made, the cost of those investments, and how they are funded, get transferred to the utility.

The government needs to provide support to the utility – whether privatized or corporatized – to realize collections. One key area is making electricity theft and non-payment of billed arrears a criminal offence. In areas where power theft is entrenched, this may require transitional support of the newly privatized entity through participation of local or national law enforcement in collections, meter installation or repair, and/or shut-offs.

[2] "The Mexican Electricity Sector: Economic, Legal, and Political Issues", Carreón, Victor and Armando Jimenez, Stanford University, January 2003

The use of regulatory bodies is fairly new in developing economies. Often, this concept was mistakenly used in an attempt to strike a balance between the inherently political urges of the legislative establishment and the entrenched inefficiencies of the legacy state-run utility system. It is important to remember that an independent regulator is first and foremost an *economic* regulator. In many countries the regulator simply took the place of a government ministry and got involved in day-to-day operating issues. These bodies are often comprised of ex-state utility staff, former energy bureaucrats, or former politicians. Such regulators have typically shown themselves to be "pro-consumer" by being reluctant to increase tariffs, but ultimately prove themselves to be anti-consumer by not supporting quality of service at adequate levels. Making the "regulator" a related party to the government tends to reduce it to the level of political agent rather than being an objective custodian of the power sector, which must seek a balance between investment/operating needs and consumer prices. The utility has one lone voice against many different, yet powerful constituencies that often keep the regulator focused on a populist agenda. Regulators tread a fine line between approving tariffs that would keep a utility solvent, and being labeled as vested agents of the utility. The waters become even murkier if the utility has been corporatized but still remains in the hands of the government. The public, politicians and, at times, legacy members of the utility themselves believe that even a corporatized utility should retain the vestiges of public service. This can lead the regulator to force the utility to perform loss-making activities. In Orissa, India, the Orissa Electric Regulatory Commission was given the reins to the result of a deficient privatization process where existing losses had been dramatically under-accounted, and the new owners asked to accept aggressive performance improvement plans based on those estimates. Once it became clear that the tariff under which privatization originally took place was insufficient for commercial performance, the regulator did nothing to review or change the framework, leading to the distribution company's failure. [3]

Power sector reform legislation needs not only the proper wording to assure that an appropriate level of authority and independence is assigned to the regulator, but it also requires the on-going demonstrated support of the political establishment to give the regulator legitimacy, and to uphold the decisions taken at the outset of the reform program. Doing otherwise can emasculate the regulatory function, undermining its authority and undoing the potential benefits of the reform process.

Need to overcome chronic underinvestment

Transformed utilities, whether the product of corporatization or privatization, often must overcome a legacy of underinvestment in physical infrastructure. Under their original mandate, state-owned utilities were meant to reach as many people as possible through their annual budget expenditures. This led many utilities to focus on system expansion rather than maintenance of existing infrastructure. The result has been uniformly poor operating service. Equipment has been pushed far beyond its technical specifications and ordinary service life as there is no option to replace it. As state utilities are corporatized or privatized, in the absence of mandated performance improvements, there is low incentive to provide new investment or maintenance to low value portions of the network where customer remuneration to the utility is weak and/or where customer density is low.

Billing and collections

Utilities often struggle to make collections from customers, and it is these struggles the utilities often cite as the reason for poor service. However, frequently it is the case that utilities are not issuing proper or regular bills to customers. Some utilities bill infrequently (e.g. bimonthly,

[3] "Power Sector Reform in Orissa: Lessons for other states in India", World Bank PPIAF report, April 2002

quarterly) such that outstanding balances become too large for marginal consumers' budgets. Other times, bills come seemingly at random, causing doubt and confusion with the customer regarding their legitimacy as well as complicating their budgeting process. Some consumer classes fail to receive bills at all. Billing errors are rampant. Some utilities must use unreliable postal systems to send their bills, while others charge their technical service staff with delivering them. Some customers do not have registered addresses.

Ultimately, customers, resist making payments for services for which they have not received proper documentation. By extension, customers wonder if they will receive proper credit for the payments they do make. Technical staff not trained in commercial matters or customer service often take advantage of the system to demand under-the-table payments.

Many developing market utilities make it difficult for customers to remit payments. Customers often have to go to distant, crowded and inefficient collection centers to make their payment. Collection hours are usually during the middle of the workday, forcing customers to make extreme sacrifice just to pay their bill. Few are willing to go through the time and expense to make payment. In many countries there is currently minimal impact on the customer in the event of non-payment, so arrears continue to build. Thus, even in instances when proper bills are issued, collections often run many months in arrears.

Complicating matters, many state agencies and/or government-owned enterprises simply do not pay, knowing that the government will not shut them down and throw people out of work. This establishes a poor precedent for payment compliance by other consumer classes. Chapter VIII, Cash Collection Efficiency, provides an approach to handling these issues.

Figure 2-2 – Overview of developing market utility performance

Country	Utility	No. of Customers (000)	GWh delivered	Technical Losses		Commercial Losses		Collection Rates	
				Pre-reform	*Post-reform	Pre-reform	*Post-reform	Pre-reform	*Post-reform
India	APCPDCL	5,125	17,248	30%	25%	35%	25%	25%	40%
India	North Delhi	800	6,000	48%	41%	‡	‡		
Mongolia	Eastern Energy	7.6	40	14%	13%	40%	11%	N/A	N/A
Indonesia	PLN Batam	110	658	14%	10%	35%	1%	40%	98%

* For all companies, 'post-reform' indicates current status of achievement. All reform processes are on-going.
† Total of technical and commercial losses.
‡ Data available only for combined technical and commercial losses. Reform process initiated in July 2002; 'post-reform' numbers indicate on-going progress achievement through July 2004. Target agreed with regulator is 31% total loss by July 2007.

Customer service and service quality

We classify customer service in two categories – 1) the relationship and attention paid by utility staff to the customers and 2) the technical quality of power the customer actually receives.

There is a chronic lack of focus on customer service within utilities. In general, demand exceeds supply so the utility has a captive customer base with little incentive to improve service. Customer relation protocol in utilities is so basic that it is difficult for a utility to know if a problem has been followed up and adequately rectified. Given that many utilities' struggle merely to

deliver power, individual customer complaints go un-logged, unnoticed and unaddressed. Unaddressed service complaints often reflect themselves through withheld customer payments. Customers lack incentive to pay their bills if service problems remain unsolved. This creates a circle of destructive relationships.

Much of the utilities' poor performance in customer service is due to two key issues: a lack of information about customers and a lack of a process or desire for addressing customer service. In many countries, customer information is kept on paper in regional offices. The utility as a whole knows only what the regional office conveys about aggregate customers via paper records. Often, these records are inaccurate or out of date. This is particularly the case for customers living in rural areas. Given a customer's anonymity within the greater utility, there is increased potential for service complaints or connection requests to either fall through the cracks or worse become subject to the influence of corruption. Without such records, it is impossible for a regulatory body to monitor customer service performance, relying instead on utility self-reporting. Improvement management information is covered in detail in Chapter VII.

Strained distribution systems create further economic problems for the utilities. An overtaxed distribution system experiences widely fluctuating draws from both registered and unregistered sources. As a result, a "good" operating frequency tolerance in many developing market utilities is a fluctuation of 5.0 Hz +/-. By comparison, an "emergency" situation in a typical OECD market grid is triggered by a fluctuation of 0.5Hz +/-. Large voltage drops across developing market grids are also the norm, with some areas losing as must as two-thirds of their scheduled voltage for customers at the ends of the system. Utilities combat these power quality drops by curtailing service altogether, in some cases for the majority of the day. As a result, customers find it difficult to justify payments for unreliable power service that causes damage to appliances or subjects them to frequent inconvenience.

Given the consistently poor availability and quality of power supply in many countries, it is difficult for consumers to see the trade off between reliability or quality of power service and having to pay for that service. Commercializing utilities may need to demonstrate marked improvements in customer service and quality of service in order to engender consistent bill payment and dispel the implicit mistrust the public associates with utilities – whether publicly or privately held. Until both the quality of power supply and the level of customer service improve, there is little chance for utilities to amicably and commercially secure customer performance on billings. Targeted reinforcement and overhaul of selected elements of the distribution system can help improve power quality. Further, running diagnostics that identify heavy or unusual load draws can assist the utility in tackling the power quality issue. Chapter VI and VII, helps address this issue.

Corruption

In many countries, corruption amongst utility employees is one of the great barriers to realizing commercial performance. There needs to be enforced elimination of corrupt practices. However, many utilities have vast networks serviced by inappropriately supervised and low paid staff that often are able to establish lucrative businesses in selling connections or earn extra money for prioritizing repairs. Following the rules leaves them with no opportunity for advancement and greatly reduced incomes.

The principles of corporate organization and accountability designed to eliminate the presence of corruption within the utility are detailed in Chapter VIII. Utilities need to incentivize their staff on an above-the-table basis through clear performance measures and remuneration commensurate to achieving the goals set by such metrics. This can be reinforced by having

appropriate levels of staffing to handle both technical and commercial service functions at attractive levels of pay. Employee performance must be monitored, particularly in the initial transition stage, to ensure corrupt practices do not continue. Employees who violate the rules must be swiftly prosecuted to demonstrate that the utility is serious about eliminating corruption.

As an example of one means to combat corruption, Andhra Pradesh Central Power Distribution Company in India has established "vigilance squads" that act independently of regional and local utility management to seek out illegal connections at the consumer level and target corrupt practices at the utility level in order to improve collections. Arrests and fines have increased dramatically in the service territory as has the number of customers requesting to regularize their illegal connections. More importantly, utility staff have been prosecuted for corrupt practices; the first step to breaking the cycle of losses and poor customer service. [4]

Energy Balances

One of the biggest problems facing distribution companies in developing countries is that they do not have a clear picture of the cost or benefits associated with their service. As a result, it is almost impossible for them to determine where losses occur. This is a key oversight in operations management that does not permit the company to focus maintenance efforts and capital investments on the areas of operations that will provide them with the highest return.

For example, utilities find it far more remunerative to consistently meter and bill customers in higher value urban areas where both per capita consumption and tariff rates are higher. But what about rural areas? Should distribution company investment be directed toward metering as a top priority? Can sufficient money be saved to justify the cost of monitoring and investment in such areas? Would technical upgrades provide a better means to control losses? Most utilities do not have sufficient information about their system – including infrastructure, customers, performance, etc – to make rational decisions on where to focus investment.

Utilities need to balance the energy inputs and outflows of their system in order to determine where the largest problems exist, where to channel efforts and in which order of priority. One of the greatest hindrances to focusing efforts is a lack of data. Chapter V of this handbook addresses how to design and implement a system energy accounting program.

Importance of Data

There is a tendency to blame certain consumer segments – the agricultural sector in particular – as the root of a majority of commercial losses. However this accusation is often leveled without having a proper accounting of costs of service, consumption patterns and collections. The fact is that many developing market utilities do not have a good handle on their cost of service and where losses – both technical and commercial – occur in their systems. Collection of data covering both energy delivery and end-use consumption can assist utilities to identify areas for commercial performance improvement and to prioritize those programs. This is why implementing an appropriately scoped program of calculating system energy balances, discussed in Chapter V, coupled with a comprehensive metering program, discussed in Chapter VI, is so important.

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[4] In the period three month period Nov 2002-Jan 2003, APCPDCL anti-theft squad authorities booked almost 26,000 instances of theft and made over 500 arrests. Most booked cases result in payment of arrears, thus charges are dismissed. Since the start of the program in August 2000, over 150,000 theft cases have been registered resulting in over 4100 arrests, including some 250 utility employees. Source: *Issues and Challenges in Controlling Electricity Theft and Revenue Leakages – a case study of Andhra Pradesh, India;* K. Durga Prasad, Joint Managing Director, APTRANSCO, 26 February 2003.

Too often utility managers, regulators and government officials call for universal metering of consumers and raising tariffs. In many areas this immediate fix may not be practical or achievable. This is particularly the case in the agricultural sector where the farmers' current economic state and the proportion of their annual revenue the full cost of power would represent make realizing collections untenable. More detailed examination of costs of service could provide alternative means for achieving at-scale improvements in economic performance by means other than tariff collection. There may be higher return, lower effort means by which to decrease losses that would be far more effective.

Taking a different approach to economic improvement could garner order of magnitude benefits. For example, a study of one agricultural region within Andhra Pradesh Central Power Distribution Company service territory showed that established tariffs only cover approximately 5% of the utility's power purchase cost[5]. Current collections among agricultural consumers were as low as 10%, thus even improvement to 100% collections would barely dent cost recovery. Shifting focus to technical loss reduction and demand-side management programs would have much greater return to the utility. By subsidizing the cost to purchase higher efficiency water pumps over the prevailing hand manufactured brand, the utility could recapture that investment in between 12-18 months on reduced power consumption alone. Conversion of distribution systems from low voltage to high voltage could reduce technical losses by 12-20% and virtually eliminate theft along lines.

In another example, the chronically troubled Delhi Vidyut Board in New Delhi, India tended to blame its extremely poor power quality and under-funding on theft of power. Unaccounted for power totaled more than 50% of power purchased. However, an independent analysis found that inaccurate or infrequent billing, or absence of billing was equally to blame for commercial losses as was theft. A comparatively simple billing and collections reform processes could eliminate between 15-20% of losses while improving relations between the utility and its customers.

Data alone cannot salvage the performance of the distribution utility. But it does provide the factual backing for investment decisions, guides maintenance efforts, offers the basis for communication of improvement needs and progress to constituents, and assists regulators and legislators in making informed policy.

Importance of Regulatory Frameworks and Legal Institutions

There is a natural split between utility entities that have been corporatized versus utilities that have been privatized outright. For the former, the state still maintains its full equity stake in the business and, as such, retains the potential for exerting influence over how the business is conducted even if this right has technically been delegated to the utility. Internally to the utility, professional management may dilute this influence somewhat, but externally, it can be influenced through how government enforces sector policy or how it imposes legislative changes on the utility.

In privatizations, the investor puts capital at risk in the hopes of yielding profit and growth from their investment. Investors have often agreed to take on the rights, responsibilities and obligations of operating the utility under pre-determined levels of performance improvement. Without the legal right to operate their business in a way that yields profitable, stable earnings,

[5] Water-Energy Nexus Activity, USAID, 2003 – currently unpublished.

the venture is destined to fail and the government moves back to square one in attempting to address its power sector woes.

Whether a utility is corporatized or privatized, there is a need for sound, stable utility policy and regulations. The government must support these reforms particularly in their initial stages. Reforms need to be backed up by rule of law, so that the utilities can rely on the contracts struck with the government and enforce commercial operating performance. It is difficult for a utility whether privatized or corporatized to enact meaningful reforms or improvements without the support of regulators, government or the rule of law.

Corporatized Utilities

A strong, well designed regulatory framework supported by clear legal protections provides the best foundation for achieving commercial performance improvements within the utility. While it is possible for determined utilities to push forward with performance improvements without clear policy support, the job becomes significantly more difficult, relying instead on the willingness of utility management and its staff to enforce change. Without legal backing, the utility may find it difficult to enforce collections and disconnections needed to improve fiscal performance. In recently corporatized state-owned utility entities, entrenched traits of a more socially-based policy era are often hard to break. It also may be difficult to justify significant capital expenditure, or even secure the funds with which to carry it out, without clear signals that such investment will be compensated through tariff.

Privatized Utilities

The absence of definitive regulation and legal support makes outright privatization of a utility a high risk proposition. Entities bidding for a utility under such uncertain conditions will compensate for the uncertainty through significantly lower bid prices and greatly reduced statutory performance improvements. In addition, government guarantees may be required. From the privatized utility's perspective, regulatory and political influence bear much more weight on whether their transition to ownership and commercial operations is successful. Clear regulatory direction and a reliance on the rule of law are of paramount concern. Privatized utilities often must make at great cost substantial investments in the improvement, overhaul and expansion of service infrastructure. They need assurance that they are going to be able to recoup these investments. The best means for providing this comfort is a clear, stable, consistent regulatory framework within which to operate backed up by recourse to an impartial legal system. In many developing markets – and some established jurisdictions – this is an extremely tall order. However, the consequences of not providing such an environment can be dire. Investors in Brazilian distribution company privatizations have been saddled with high risk and non-recoverable losses due to an inconsistent regulatory framework that only partially liberalized the electricity value chain. Utilities were unable to pass through to customers the skyrocketing cost of bulk power purchases from the liberalized wholesale market since the regulatory framework provided little latitude for adjusting consumer prices.

The Role of Government

There is a need for the political will to draft effective legislation, pass the laws, believe in them and create the environment and the ability to enforce them. While utilities can cope with policy vacuums for short periods, the long-term viability of the utility is dependent on good policy.

The government must come out publicly in support of any reform program. Communications must be clear an explicit, stating the reasons for the evolution in policy. The public must be made aware that there is mutual benefit in an act of corporatization or privatization and assurance that consumers will receive adequate protection as long at they play by the rules.

The government has an important role to play in enabling utilities to operate on a fully remunerative basis. Laws and policies should support a commercial billing and collection system. In some countries, this requires the bold step of passing laws that make theft of power a criminal offence or that permit utilities to disconnect delinquent customers. In the early stages of implementing such laws, there should be willingness of the government to back up those policies with police protection or assistance to the utility. What such laws do is to both enforce fiscal discipline on customers or, in cases where such structural oversights have, either intentionally or unintentionally, provided 'benefit' to certain sensitive political constituencies, such as the chronically poor or employees of state-owned industries, take these *de facto* subsidies and effectively and explicitly shift the burden to the government[6].

If the political establishment feels it is either necessary or in their party's interest to cater to specific consumer segments or constituencies, this must be brought to the level of the government and not buried in the commercial workings of the utility. If, by political mandate or economic reality, it is deemed that consumer classes must receive subsidized service, it should be recognized that this is a government policy decision and not an operating decision of the utility. The government should make an explicit line item provision for utility subsidies in the national budget. If the subsidy is provided to the utility directly, utilities should account for and still charge the full, remunerative rate for service with subsidies shown explicitly on the consumer bill. If the subsidies are provided directly to the consumer, the utility could charge the full economic rate in its bills. By definitively moving the subsidy burden to the government, opaque, artificial tariff rates can be eliminated in order that consumer gets a clear price signal of the true cost of the power they consume. Either way, the goal should be to separate the burden of subsidies from the utility and assign it to the government. Governments must be made to own up to the economic impacts of policy decisions or positions by budgeting explicitly for subsidies. However, disbursement of these subsidies should be coordinated with and monitored by the regulator.

Given the movement to such fiscal accountability, it is only fair and proper that governments should seek demonstrated performance on the part of the utilities to cut their technical and commercial losses. As has been observed in some countries, notably India, subsidies received from the government are often used to prop up deficient operating practices at the utility rather than truly subsidizing the cost of service to customers. Customers see little value from the subsidies as their quality of service remains low. Realistic operating and performance goals could help improve the efficiency of subsidies, setting the utility on a path to reducing or eliminating these monies. The tools described later in this handbook, particularly energy balances and demonstrated collections performance, can assist is establishing performance baselines and in creating a strategy for improvement. To provide a solid, defensible foundation, there should be a regulatory compact among the regulator, utility and government that provision of subsidies will only come through joint effort in reducing the technical and commercial losses in the sector. The regulator in its role as custodian of the utility sector, should monitor utility performance and operations in order to separate true operational challenges from "free riding"

[6] We emphasize that free power and uncollected arrears are a quote-unquote benefit, since the short term relief of payment is rarely beneficial for the public at large and is typically greatly offset by any of the following: subsidy to the few at the expense of the many; decreased service qualify, increased cost to the consumer due to burn out of electrical equipment directly resulting from poor power quality, paucity of funds in the utility to conduct ordinary preventative maintenance. Indeed, as was found under a USAID-funded study of agricultural pumping connections in Andhra Pradesh, India, if distribution system power quality was maintained, elimination of pump motor burn outs would permit customers to afford a tariff about five times greater than they were currently being charged. In addition, farmers surveyed were willing to pay a higher rate for higher quality power, but only if it was reliably available.

on subsidies. Further, the regulator, through the approved tariff structure, should see that subsidies are being both calculated and applied correctly.

Rule of Law
No matter how good the policy or piece of legislation, or how detailed the contract, none of these is of value unless there is the rule of law to support it. Privatized entities need to be able to rely on contracts that are struck with the regulator as much as contracts struck with their customers. Utilities need to be able to reliably enforce their right to collect monies from customers, disconnect delinquent customers, and remove illegal connections – assuming such rights exist. The rights of each party subject to the regulatory compact - the utility, the government, the supplier, and the customer – must be explicit and clear. Gray areas create places for convenient interpretations, reneging on obligations, and a lack of consequence for poor performance. Defenses and remedies must be available through the court system and those charged with enforcing the law, including politicians as well as police, must be both willing and able to clearly and decisively support the laws that have been duly passed by the government. Without such support, there will be a lack of confidence from consumers that there will be change for the better and votes of no confidence from investors who will steer clear of power sector opportunities.

Summary
In summary, there is a need for strong and clear enabling legislation that allows a utility to pursue delinquent accounts, affect shutoffs, realign tariffs, etc. There must also be supportive political will and policy that upholds the sanctity and effectiveness of these laws. Accordingly, providing a strong rule of law and supportive legal system is also an important component. Finally, there needs to be the will of the body politic to either undertake the near impossible task of desisting from catering to voter blocks through power policy or to allow the regulator to do its job. Without these institutional supports, a utility through sheer will can yield performance improvements, but the task is made infinitely more difficult.

Four Axioms for Power Sector Reform

Based on extensive experience in power sector reform throughout the world, we have identified four axioms that provide a basis for successful reform. These principles were developed by encompassing the broad scope of needs, challenges and pitfalls outlined in this chapter. The impact of these axioms is pervasive, and should influence how governments and utilities set about the reform process.

- ***Accountability is the basis for reform.*** Accountability is the result of authorizing a person or entity to take certain actions, establishing a target against which the success of those actions may be measured, measuring that performance, and rewarding or sanctioning the person or entity based on performance against target. The inertia that grips much of the power sector today in developing economies can only be overcome through vigorous imposition of accountability at every level of the sector. Accountability is implemented through processes imbedded in organizational culture. Developing countries, especially those in the former Soviet Union, must resist the old “Command and Control” form of accountability, however, in favor of accountability in a commercial sense. Privatization and/or the introduction of competition do not automatically create these processes or culture. On the contrary, an environment of accountability is a prerequisite for successful privatization or competition. Reform efforts should therefore focus first on creating systems of accountability that can support subsequent changes in ownership or market structure.

- ***Ownership for reform must be built through participation.*** This entails two concepts. First, reform can only be successful if there is local ownership of it. Second, this ownership can only be built through local participation at all stages of the reform program. Issuing reports does not create participation. Rather, all reform activities must actively involve stakeholders. To date, the governments of many developing countries undertake reforms very reluctantly and, therefore, often do not take any ownership of the process. In the past, reforms have been undertaken to appease Donors, especially the World Bank, ADB, and IMF which hold the carrot of large loans or other forms of financial assistance. Such an approach does not foster local ownership of the reformed utility policies and processes. It must be acknowledged that every country is different and, while donor agencies have a strong facilitating role to play, local governments, utilities and entrepreneurs must be allowed to customize global tools in the domestic context.
- ***Reform requires a holistic approach.*** It is relatively easy to answer reform questions regarding the appropriate number of distribution companies or the calculation of tariffs. It is more difficult to develop resilient and effective processes that will enable stakeholders to maintain reform momentum as conditions change. It is harder still to truly empower stakeholders through education. Reform success depends in part on creating and motivating institutions to fulfill their roles in a restructured sectoral environment. The approach to reform should encompass technical content, processes and people to produce results. Further, targeting one aspect of operations without considering how that element interacts with or influences the balance of the sector can lead to ineffective, suboptimal or even destructive results.

  For example, independent regulation is often seen as a solution for the poor performance of state run utilities. However, the effectiveness of power sector regulation depends upon the degree to which these utilities respond to the principal tool of regulatory control – tariff setting. It is an un-stated assumption taken from developed western countries that regulated entities are motivated by better financial performance, and hence are responsive to regulatory directives backed up by the prospect of tariff adjustments and incentive mechanisms. However, state utilities are often governed according to many non-financial considerations as well, and the imported model of regulation can suffer as a result. Reform efforts must therefore extend to matters of corporate governance. A primary issue in the case of State Owned utilities is how to utilize incentives when there is not a significant profit motive on the part of the company. The solution may be to provide financial incentives to employees for good performance.

- ***Reform must enhance social development and equity.*** The power sector is complex and sector reform requires detailed technical analysis of relatively arcane topics. In the midst of such analysis and discussion it is easy for financing agencies, consultants and government counterparts to lose sight of why they have embarked on reform. One can be assured, however, that the ultimate constituency of reform, the public, will not lose sight of those objectives. They will demand that the reform program delivers the socio-economic benefits they have been promised. A reform program must continually justify itself in terms of social benefits achieved, and ensure that these results are conveyed clearly to public. It is important for utilities and their institutional counterparts to keep track of progress through explicit, transparent measures forming a “Reform Scorecard” that provides an indicator of progress.

III. Taxonomy of Operational Reforms

Whether a distribution utility has been privatized or remains under state ownership, the operational reforms discussed in this handbook are equally applicable. While some argue that a privatized utility has more flexibility and incentive to undertake operational reform, the policy, legislative and regulatory environment under which any utility operates has a tremendous impact on its ability to achieve improvements. Corporatized state entities have commercially minded management and regimented government caretakers that give the utility the ability to achieve sustainable, remunerative operations. However, the government needs the will to create and the discipline to protect the institutional framework that supports commercial utility operations; otherwise any corporatization/commercialization program is doomed to failure. As discussed in Chapter II, these supports are pre-requisites to affecting the operational changes contemplated herein.

In this chapter we discuss some of the key success factors needed to design, implement and sustain utility operational reforms. Not all of these are purely within the traditional technical operations. Communications with stakeholder groups is imperative as their input is rarely solicited and their grievances often house the origins of dysfunction in collections. It is important that utilities clearly and realistically define core specifications for performance improvement allowing transparent measurement of success. Utilities can also benefit from use of outside help with operational reforms. Outsourcing activities or even microprivatizing portions of the grid can help spread the risk of reforms, quickly gain access to needed expertise, or allow appropriately motivated entrepreneurs to tackle localized performance improvements.

The operational reforms highlighted in this handbook focus on getting more cash into utility coffers and eliminating wastage. This is done by making certain utilities measure what they buy and what they sell, issue proper bills and collect those bills, and improve service to the customer. It sounds basic, but it can be a very large, difficult task. If it was easy, there would be few poor utilities in the world. It must be kept in mind, however, that in order to achieve those operating goals there are many complex obstacles to overcome. In this chapter we address the taxonomy of operational reforms and review the keys to success. Among the most difficult of these obstacles are human factor issues. Customers who receive poor customer service and poor power quality do not make willing or reliable payments. A utility that does not get proper funding or payment for its services is not very motivated to perform. Workers who are either under- or over-utilized, not appropriately monitored, inadequately compensated, suffer from poor job design or business process tend to be underproductive, inefficient, susceptible to the temptation of corruption and generally exacerbate operational problems.

Two Paths of Structural Reform

Globally, national distribution sectors are either undergoing or considering massive reform. There are two primary forms these changes take: privatization or corporatization. In the latter form, the utility retains its state ownership but is restructured to be managed and function more like a corporation. The goal of corporatization is to allow the utility to function on a commercial basis.

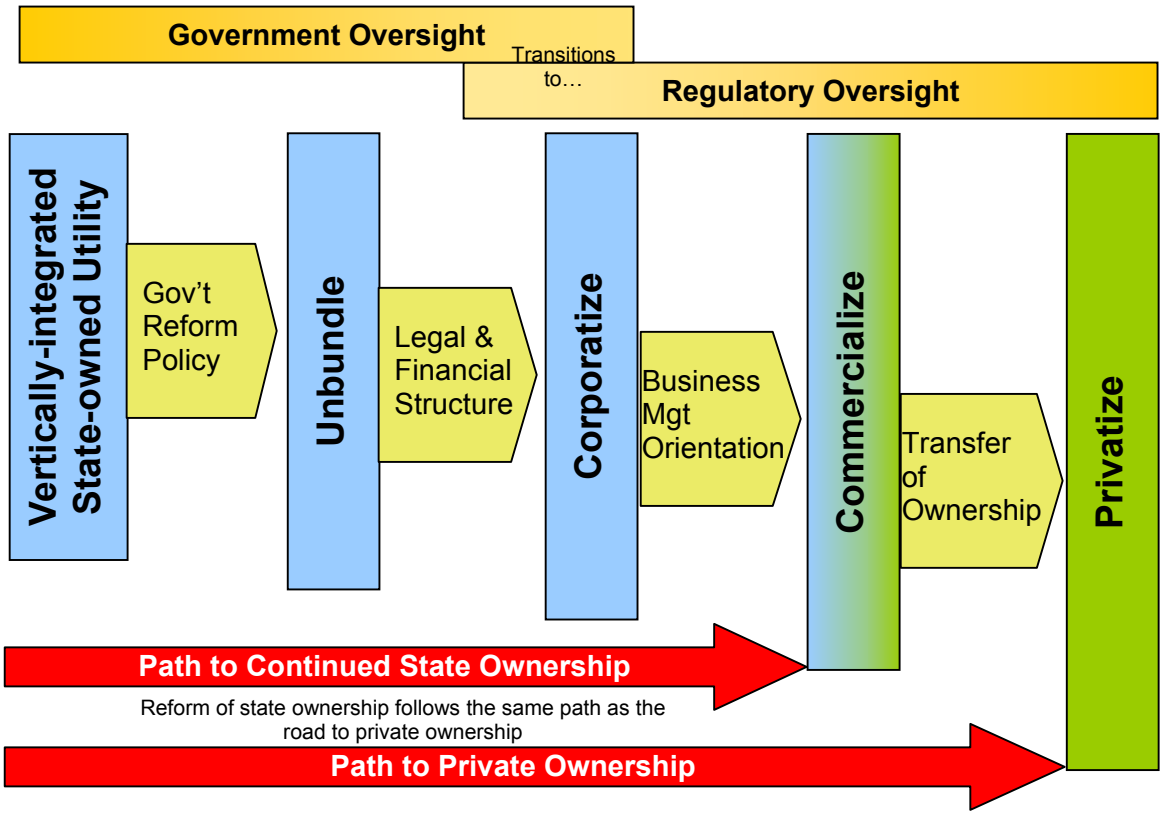
Under either reform framework the operational improvements described in this handbook are equally applicable.

Firstly, we present the reform continuum that chronicles the pathways that can lead to either a privatized or commercialized state-owned utility.

The reform continuum
Figure 3-1 shows a typical progression from vertically-integrated state-owned utility to a privately-owned entity with the scope of the two paths of structure reform highlighted in red.

Figure 3-1 – The Reform Continuum

The figure shows that there are four distinct phases of reform through which a utility can migrate:



- Unbundling – the utility is separated into its functional components: generation, transmission and distribution. If the utility is large, this unbundling can be accompanied by further rationalization into appropriately sized subsidiaries.
- Corporatization – a professional management structure is introduced that is distinct and separate from the government political and ministerial system. The sole focus of the new management is to transform the utility from a public service to a self-sustaining commercial entity.
- Commercialization – the utility is run as a commercial business, with tariffs that, at minimum, meet the cost of service or preferably provide a return on capital employed (or other

economic measure) in order to help fund investment. A commercialized entity answers to a regulator and is thus freed from political interference.

- Privatization – ownership of the utility is transferred from the government to the private sector. The private owners are responsible for both operating the utility commercially and funding new investment. It answers to an independent regulator free from political interference.

The figure shows two paths, one leading to retained but reformed state ownership, and the other leading to private ownership.

Initially state-owned utilities are directly managed by the government. There is, however, a point in the transformation process where introduction of a regulatory body is appropriate. If a utility is expected to perform like a corporate entity, it must be regulated like one. Having an independent oversight body plays an important role in facilitating a commercial operating environment by providing a check and balance against government intervention and maintaining a watchful eye over utility performance.

What the diagram highlights is that, if retained state ownership is desired, there still must take place a process of unbundling, corporatization and commercialization of the utility. It is not enough to merely unbundle or corporatize the utility. Implementation of commercial processes is essential to achieving improved commercial operations. Under a privatized structure, these practices would by definition already need to exist.

The processes outlined in this handbook reflect the type of operating practices that would be needed to support either a commercialized or privatized utility.

Privatization
Privatization transfers either operational rights in the form of a concession, management control, majority control, or outright ownership of the distribution utility to a private sector entity. Privatization policy design has run the gamut from highly defined performance improvement and investment criteria to a completely unstructured laissez-faire transfer of control to the private sector. Regardless of the format of privatization, delivering service improvements to customers and the ability to generate profits to investors are the measure of long-term benefit of the process. Realizing operating level improvements is the key to that success.

Mixed results
Privatizations have yielded mixed results. There have been many cases where the government plan for privatization was incomplete, focusing instead on the initial money raising aspects of the sale rather than viewing utility service as a long-term going concern. In more recent cases the focus has been on setting clear operational improvement milestones and target dates for their achievement as part of the conditions of sale. Often privatization has been accompanied by introduction of a new or radically changed regulatory function, creating new oversight challenges between former governing entities and their new, unproven sector masters. Regardless of the approach, even the best planned privatization has been fraught with anxiety either from consumers, investors, politicians or all. It has tested the ability to craft and implement new policy and institutions from scratch. Yet it remains an attractive means by which to salvage a chronically underperforming sector, dissemble a politically broken apparatus and/or assist in reducing major debts run up by the utility in support of its public service obligation.

There are many reasons why countries decide to pursue a course of privatization, however it is usually fiscally driven. Whether alone or in combination, deciding factors typically fall within the following categories:

- Inability of the utility to generate sufficient funds to expand or, at times, even maintain its system. Inability or unwillingness of the state to provide the necessary capital or budgetary allocations to finance such improvements
- Poor service performance of the utility, whether in providing expanded access to power or quality of existing service
- To foster a reduction or elimination of subsidies
- To reduce or eliminate debt of either the utility or the government at-large

Operational improvements are key

Whatever the goal of privatization, experience has shown that a clear, detailed policy and legislative framework is required to ensure success and support efforts made by the newly privatized entity to improve operations.

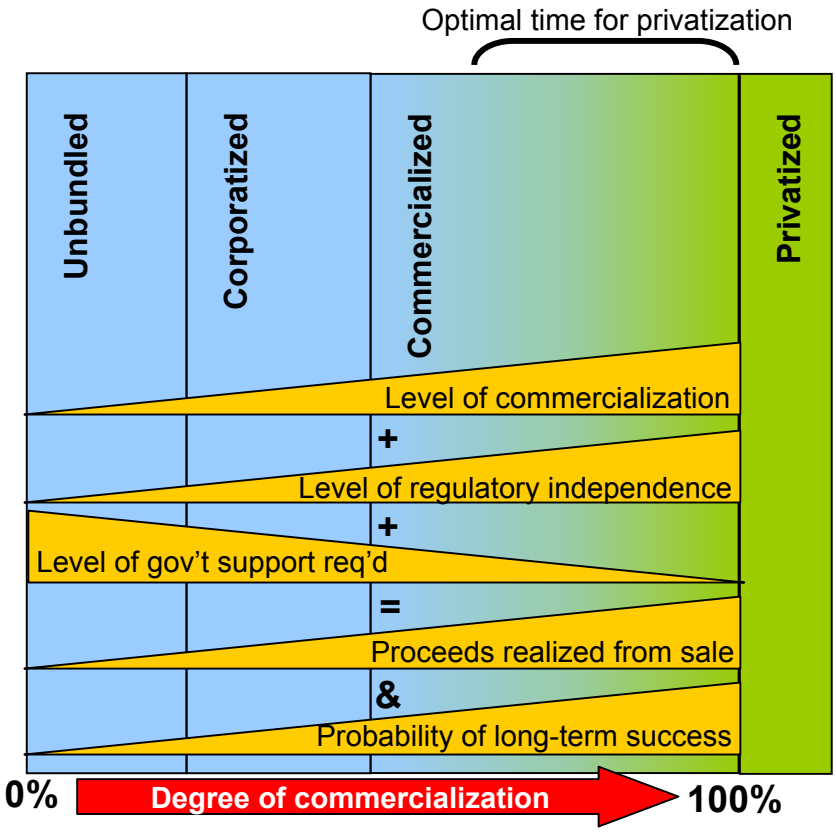
The least successful privatization programs have bypassed the corporatization and commercialization phase and jumped from unbundling directly to privatization. Such approaches let the new owners deal with breaking decades of destructive but entrenched internal practices that helped to create the need for privatization in the first place. In other cases, the corporate framework was created but little progress was made to develop commercial practices. Often times this was due to entrenched labor practices, the legal inability to reduce staffing complements or enforce disciplinary actions, lack of legal rights to disconnect customers or enforce fines, penalties or criminal judgments against theft of power – some of the key elements that lead to deficient utility performance. The regulatory and legal framework needs to be sufficiently advanced to support these tools to allow privatized entities to achieve reform.

In practice, privatization has had mixed results. This is not a fault of the concept, rather the implementation. In several markets, such as Brazil and Hungary, the privatization process was a quick way for governments to raise cash to pay off either utility debts, general government debts or divert funds for other, unrelated purposes[7]. In other cases, privatization was a convenient way to transfer the obligation of utility service from government to the private sector, thus protecting it from blame and responsibility in the event of service shortfalls. As such, little policy structure was provided to govern the on-going operation of the privatized entities. Problems surfaced once the benefits of the funds inflow evaporated and the constituencies – owners, government and customers – had to deal with the longer-term reality of their new situations. What experience has demonstrated is that new private sector owners, lacking a predetermined or pre-agreed path for service expansion and improvement, will seek to reap the greatest gains in profitability through the lowest level of investment. Often in countries that lack performance structures in their privatization schemes, politicians, bureaucrats and customers alike have been disappointed with the results of privatization. This has led to counterproductive political actions, partial reversal of sector liberalization, or public protests.

[7] In the period 1995-2002, Brazil as a whole raised US$77 billion and transferred US$29 billion of debt to the private sector as a result of power sector privatizations. However the electricity sector regulator, ANEEL, was not established until the end or 1996, significantly after the first privatizations. The first rules governing the private market were not instituted until 1998 and their evolution is still underway, with the latest major rules change implemented in 2003.

Figure 3-2 – Level of Commercial Development Impacts Privatization Success

The figure represents actions taken or requirements of state-owned utilities proceeding along the path from initial unbundling through commercialization. The point along the evolutionary scale at which privatization is attempted directly impacts its degree of success, both in terms money raised and prospects for sustainable operations of the privatized company. Governments will raise more money from a privatization the closer the utility looks to a private entity (right side). Utilities that have not undergone operational improvement (left side) will require extensive government support and raise little money from privatization



A key contributor to the success of a privatization is the level of commercialization the utility has achieved prior to the sale (Figure 3-2). Directly related to this performance is the existence of a regulator and the degree of independence that regulator has. With these two elements in place, the required level of on-going government support can be reduced and the proceeds from the sale maximized. The point during at which a utility is privatized during a commercial operations reform process impacts its degree of success from the perspective of both money raised and the long-term sustainability of private operations. As shown in Figure 3-2, achieving between 75%-100% commercialization and a similar level of regulatory independence at the time the utility is put up for privatization greatly reduces the need for government on-going support – usually in the form of subsidies – provided to the new owners and increases the likely proceeds from a privatization sale and enhances the chances of long-term success.

In contrast to retained state ownership, if privatization is being considered, it is important to set the utility on a course of improved fiscal and operational management. This will demonstrate to both seller and prospective buyers what is the potential of the utility post-reform. While some level of basic improvement is good, it may not be necessary to go all the way to complete commercialization. As an example, information technology is often used to diagnose and improve utility operations. It is very costly and time consuming to put in place the information technology systems necessary and attendant processes required to feed these databases. The acquirer usually has some particular system it prefers that works with other systems it has in the company. It is better to let the acquirer invest in the needed technology for more advanced systems. But this does not mean commercial reforms should not be undertaken. There are

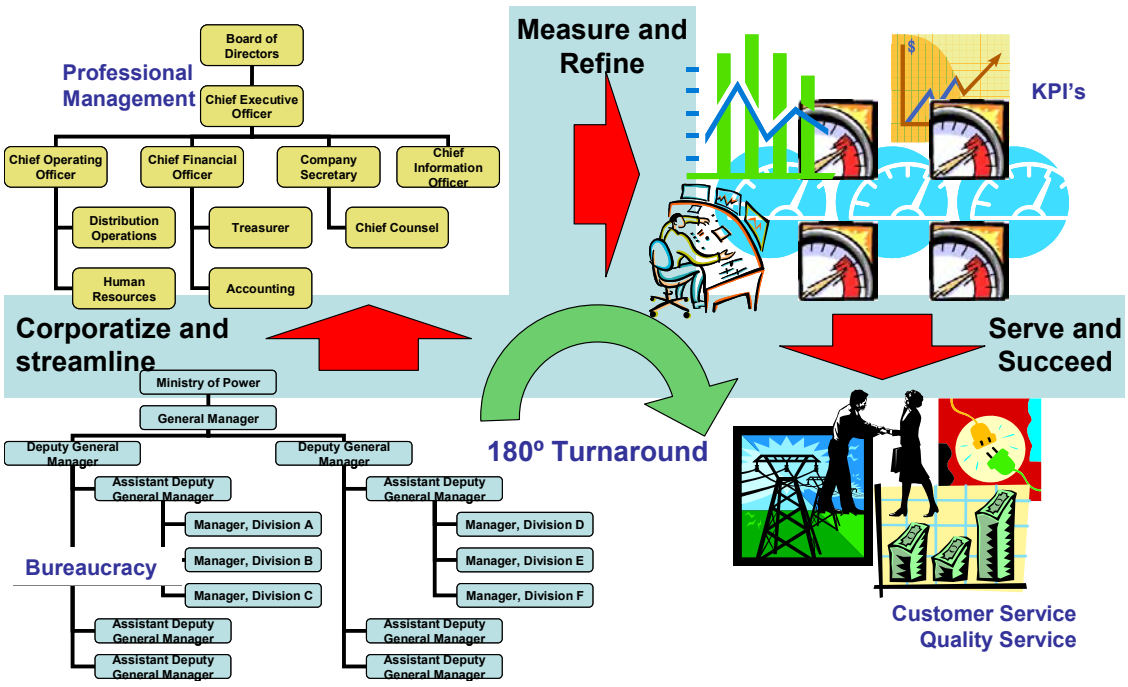
significant steps a utility can take to improve better quantify its operations and put in place the foundation for operational improvement. Undertaking energy balance assessments, collections improvement programs, improved metering are all fundamental actions that can support a privatization. This data provides a more transparent insight to prospective buyers to the true condition of the utility as well as providing a defensible basis for minimum bid thresholds called for by the government in the privatization process.

A clear path of performance improvement backed by financial incentives has proved to be the most appropriate means for achieving a win-win for government and utility alike. When improvement levels imposed on the privatized entity are unrealistically broad in scope, or are required too quickly there is great risk of disappointment, outcry and ultimate failure of the process. Along the way, customers, legislators and investors alike become disenchanted making any follow up steps more risky and difficult. However, if reforms associated with privatization are more of a continuation of commercialization reforms that were already being undertaken by the government prior to privatization, the chances of a sustainable, success outcome are increased.

State control preserved but managed independently

In the face of both reduced investor interest in privatized entities and highly publicized failures of some privatization programs, more and more governments are choosing to retain state ownership of their utilities. Despite this decision, there remains an urgent need for these governments to improve the fiscal management of the utility. In order to achieve fiscal and operating performance improvements, some governments are pursuing a process of commercialization that transforms utility operations into something more resembling a corporate entity. Typically a two step process is followed where first the utility is restructured along corporate lines with the introduction of a professional management structure. The second step then applies commercial operating measures to the corporate structure with the goal of creating a fiscally self-sustaining entity. (See Figure 3-3)

Figure 3-3 – Two Step Process of Corporatization to Commercialization



Corporatization de-politicizes the operations of the utility by separating its day-to-day governance from the ministerial system. A management structure is put in place similar to a private sector entity and various operating authorities – finance, human resources, planning, operations – are delegated to these managers. These managers are then responsible for setting performance targets and affecting operational changes that set the utility on the path to realize those goals.

Often times a regulatory function is introduced at the same time as corporatization of the utility. While under a retained state ownership structure, the government effectively serves as the board of directors, the presence of an independent regulator places a check and balance on the temptation of this 'board' to use the utility as a tool of government policy du jour. The regulator thus takes on certain governance characteristics of a board of directors, focusing on operational improvements as the first priority and revenue adjustments second in order to assure that the utility is run efficiently.

Commercialization takes the corporatization concept a step further and requires that the utility perform fiscally like a private sector entity. The inflow of collections must balance with the outflow of expenditures. Accordingly, issues such as technical and commercial losses take center stage. If the utility inherits legacy social welfare programs from the state, the government makes these subsidies an explicit, budgeted line item. The utility must create balanced annual operating budgets and responsibility for raising capital is fully in the utility's hands.

The goal of this process is to introduce to the utility a high level of autonomy from the government in order to run itself as profit-making company. In addition, as economic difficulties and lack of investor interest have sidelined many outright privatization programs, countries have found that this form of governance currently may be the only way to pursue sector reform. If designed, implemented, and supported properly, this type of reform can be effective in transforming the operations of the utility and reducing reliance on the state. It can also form the basis for future privatization.

In the past, state utilities have demanded subsidies from their respective governments to meet the substantial shortfalls in their budgets. Many of these shortfalls were blamed on populist tariff policies for agricultural, rural and certain residential classes of customer. In the corporatized era, these subsidy requests are now subject to much more intensive scrutiny. While most governments have stopped short of mandating certain levels of performance improvement, hard questions are now being asked in regard to reductions in technical and commercial losses, tightening of collections requirements, and improvements in maintenance. Plans regarding how a utility will improve power quality and customer service must accompany any request for an increase of tariff.

Much, however, is left to the utilities themselves to decide how best to proceed. This 'leap of faith' by governments is probably one step not far enough. As in the case of privatization, a commercialized state-owned utility needs the latitude to optimize staffing levels, enforce disciplinary action, shut off delinquent customers and clear illegal connections. In order for real improvements to be made, the government and utility must jointly agree a clear agenda, with realistic and measurable goals laid out on an accompanying time line. Such goals need to be clear, realistic and achievable in order to promote success. The alternative is living in a realm of the status quo where requirements and deadlines are ignored and reliance on government subsidies and loans remains.

Summary
The goals of reform programs and how those programs were designed and implemented for a given country directly influence how the transformed entities have performed post-implementation. The actual act of privatization or commercialization should only be one part of a broader, more holistic context of institutional reform. Transformed utility entities, whether commercialized or privatized, require the support of legislators, regulators and government institutions to assure long-term success. It is important to have carefully considered, realistic and transparent metrics against which utility performance can be judged. These metrics should also be combined with incentives, if possible, to drive the pace of performance. Promoting development and implementation of commercial processes in utilities is imperative. The next section describes some of the key factors that can contribute to operational success.

Putting Plans into Action: Key Success Factors

Undertaking any sort of utility sector reforms requires the efforts of not only the utility directly but also the government, regulator (if any) and, ultimately, the customers. The government, however, plays a key leadership role in facilitating the reform process. There needs to be political will to support both the direct and indirect efforts needed to affect change. The following sections outline areas that are critical to realizing change toward commercial operations within utilities and sustaining that change over the long term.

Utility level operating enhancements
Utilities need to enact and/or refine business and operating processes that enhancements their commercial performance.

- Assemble accurate customer information – billing information, location, consumption information, etc.
- Improved billing and collection methodology which may include the following if they are cost effective and appropriate to the utility and the region:
  - Outsourced billing services
  - Handheld billing
  - Door to door collections
  - Pre-paid metering
- Reduction of theft and tampering
  - Secure meters
  - Conversion of distribution systems from low voltage to high voltage
  - Increased patrolling by utility or contract personnel
- Power quality improvements
  - Maintenance
  - Upgrades
  - Control systems
- Customer service improvements
  - Connection/disconnection times
  - Service complaint response time
  - Billing accuracy and frequency

- Convenience of payment and seeking service

Government Support
There needs to be both initial and on-going government support for the operational reform process. This takes place on a number of different levels – via legislation, regulation, policy, and general communications with the public. The following summarize a number of environmental conditions that are essential to ensuring the initial success and sustainability of utility operational improvement programs:

- **Political support:** Governments – both legislators and bureaucrats – must:
  - **Refrain from using the power sector as a political tool for currying favor from certain constituencies.** There is no such thing as 'free power'; someone must pay and it usually means taking money away from equally if not more important programs. Our experience has shown that free or near-free power often winds up costing the targeted consumers more in terms of wasted resources and equipment damage due to poor power quality than the tariff would have.
  - **Transparently grant subsidies and explicitly account for them** in budgets but *outside* the operating environment of the utility. Utilities cannot be expected to magically come up with the funds required for subsidies. While most utilities do engage in some form of tariff cross-subsidization, the amount needed to balance budgets would drive the high value customers from the grid, thus further compound problems. If the government's goal is to eliminate subsidies, then legislators, regulators and utility management must sit together to craft a realistic plan and timeline of transition. There is no 'magic wand' that will make them go away overnight. If politicians see fit to subsidize certain portions of the population, government tax revenues should be applied for that purpose and accounted for in national budgets.
- Legislative support
  - **Cede utility oversight to an independent regulator.** The creation of a strong regulator can greatly aid all of customers, utility and government. A regulator appropriately constituted and empowered can act both as custodian to foster the economic improvement of a utility and protect the customer from overcharges and the damage of poor utility service. This arrangement provides benefit to all.
  - **Criminalize theft of power.** Unauthorized tapping of power lines, while not only being dangerous, is a form of stealing. Governments and regulators cannot expect a utility to achieve high levels of collections when theft of power is permitted by law (or lack thereof). If such laws do not exist, it should be a legislative priority to change that situation, sending a clear message to the public that the free ride is now over.
  - **Give the utility the right to disconnect delinquent customers.** A law is only as good as its enforcement. Criminalizing theft without enabling the utility to disconnect thieving or non-paying customers is pointless. Further, the utility should be supported in its collection efforts –with police support if necessary – especially at the outset of the criminalization law.
- Regulatory support
  - **Create commercially oriented tariff policy.** Rarely can decades of subsidized or deficit utility operations cannot be changed overnight, but effort must be made to set tariffs on the correct trajectory. We have seen a high willingness of consumers to pay for a service they believe to be necessary. We have also seen how effective tariff price

signals can be to modify consumer behavior toward becoming more efficient in their use of energy.

- **Monitor utility customer service performance.** Consumers cannot be expected to pay for substandard utility service; people expect value from the utility in return for their hard earned money. The regulator should set transparent performance standards for the utility, technically and commercially. This creates a universally understood basis for determining where a utility is succeeding or failing.
- **Audit utility finances to assure money is being spent wisely and to assure there is sufficient funding.** Associated with monitoring, the regulator should have the authority to direct the utility to undertake service improvements, using tariff authority to enforce these rulings. Customers should not be unduly penalized by tariff increases due to utility mismanagement, thus it falls on the regulator to assure the utility is doing its job. Just as important, the regulator should adjust tariffs to allow utilities to undertake reasonable and necessary capital improvements and expansion of service.

Communications
All stakeholders need to be initially consulted during the design of and continuously informed both during implementation of and after the sector transformation process. Public outreach plays a critical role in the success of any reform process.

- Early and appropriate communication with stakeholders is imperative
  - Customers need to know they are getting something back from their outlay of tariff payments
  - Use customer surveys to gauge current situation, test ideas, identify sensitive points
  - Use popular media as part of a public relations plan in order to “set the scene” for reform/service changes/new policies well to in advance of changes; this includes print, radio and TV
  - Use media to the advantage of the process by assuring they are invited to deliberations; such deliberations should have a well framed context in order to steer discussion constructively in the direction policy-makers require (e.g. tariff increases are going to happen, but the debate will be centered on trade-offs of who is benefited/penalized, who gets subsidized and the implications for other stakeholders who are not subsidized
- Engage critics directly and constructively. Provide context to the discussion and focus on the trade offs that exist between maintaining the status quo and not being able to fund other socially important programs. Focus on the money and available sources of capital. Examine impacts on various concerned constituencies and explore trade offs of favoring one class over another. Most importantly is to keep the discussion linked to other non-power sector issues. Singular focus on power allows the budgetary and subsidy impact on other programs to be diluted or ignored altogether.

Roles of stakeholder groups
It is important to head off destructive confrontation and second guessing from stakeholders by making sure each has a role in the transformation process and its on-going operations.

- Clearly define roles of utility, regulator and government to avoid contradiction
- Remove political barriers to enable economic tariff adjustments within customer classes

- Subsidies – convert 'mandated public service' into explicit, budgeted subsidies transferred from the government coffers either to the commercial operating entity or directly to the intended recipients.

Post-privatization/post-commercialization performance specifications
Stakeholders must recognize that change does not happen overnight. But chronic difficulties of the past should not be used as an excuse to relieve future improvement. A balance must be struck by setting definitive but realistic progress metrics.

- Set realistic performance improvement and system investment targets. If it has taken decades for the utility system to get into its current condition, one or two years of private sector management are not going to undo that.
- The government should define specifically which consumer groups it wants to support. A determination should be made whether such support is transitionary or semi-permanent. No matter the longevity of such support, subsidies must be explicit and budgeted with timely transfers made from the public coffers to the utility or to the intended customers.
- A regulatory compact should be established between the utility, the regulator and the government that sets performance targets in the areas of:
  - Technical loss reduction
  - Theft elimination
  - Billing and collection

  Specific yet realistic goals and rates of improvement should be agreed that will assist the government in minimizing, redirecting, reducing or phasing out subsidies.

Institutional support to the privatization/commercialization
Law and policy cannot alone create change: they also need to be enforced. The regulatory environment needs to be maintained substantially in tact for a sufficient number of years to create predictable, reliable operating conditions.

- Support from the government in upholding and enforcing the both the principles of reform legislation but also the letter of the law
- Example setting by requiring government entities and state-owned enterprises to pay their outstanding utility arrears and keep current with their bills
- Insulation of the reform process from changes in political regimes. This allows the private entity a sufficient time horizon over which to plan and implement changes in operations and the confidence with which to invest. The entrepreneur needs the confidence that it will be able to earn a return on its investment.

Adequate Funding
Utilities need to be adequately funded in order to make them more commercially oriented and/or prepare themselves for privatization. This is particularly important in the early stages of the transformation process; later improved operations should create the conditions for support to be gradually withdrawn.

Utility management should look at available funds on a holistic basis. There is no need to rely on a single donor program or a single government initiative. Fund requirements should be examined on a portfolio basis in order to maximize the opportunity to leverage different sources of capital.

- Sources of capital
  - Multilateral institutions – loans, grants, guarantees, co-financing
  - Bilateral funding – loans, grants
  - Capital markets – bonds, bank loans, share placements
  - Privatization – portions of the utility operation can be privatized in order to raise money, particularly areas that are not core contributors to operations (e.g. engineering services)
  - Outsourcing – outsourcing of services, particularly in areas where substantial new investment would be required to upgrade these services, should be viewed as a form of 'proxy capital'.

Measuring Success

Operational reforms are often daunting. There are numerous groups pitted against these efforts – customers, utility staff, and politicians. Such detractors will want to see proof that the efforts being undertaken are not a waste of money and are actually leading to improvements in commercial performance and technical operation of the system. It is, therefore, imperative that improvements are measured. More importantly, however, performance measures will assist the utility in tracking improvements in operations and flagging areas where additional effort is required, thus contributing to on-going commercial performance improvements.

This section describes the process of establishing, measuring and quantifying the benefits of the operational reform process. First, the utility establishes baseline conditions through internal technical and commercial balances. Next it tracks the progress of improvements by defining and monitoring some key performance indicators. Finally, combining the two, a utility can use the results to help finance on-going improvement investments.

Establishing baseline conditions
Establishing an accurate picture of inflows and outflows of both energy and money is an important first step for any utility. It permits utility management to target which aspects of the business are the sources of loss and which of those aspects are in greatest need for improvement. Baselines should be established for all key areas of performance being undertaken in the operational improvement program. Computing Energy Balances, discussed in Chapter V, are a primary means for measuring baseline conditions. Such key performance indicators, or KPIs, are discussed in the section below.

But such measurement also serves another, equally important purpose: establishing a baseline status of utility operations as of the initiation date of reforms. The baseline will permit utility management to demonstrate the extent to which operations improve along several key performance lines. It is the primary defensive weapon against detractors among skeptical stakeholders.

The utility must track the cost and benefit of improvements programs. An energy balance, discussed in Chapter V is one of the most important and useful tools the utility can employ in identifying and prioritizing reform efforts. Once the problems have been scoped and prioritized, the baseline conditions, both technically and commercially, can be recorded.

Establish Key Performance Indicators (KPIs)
KPIs are a critical tool used in measuring and monitoring operational performance. KPIs are both used to inform those with oversight as well as to help run day-to-day operations of the

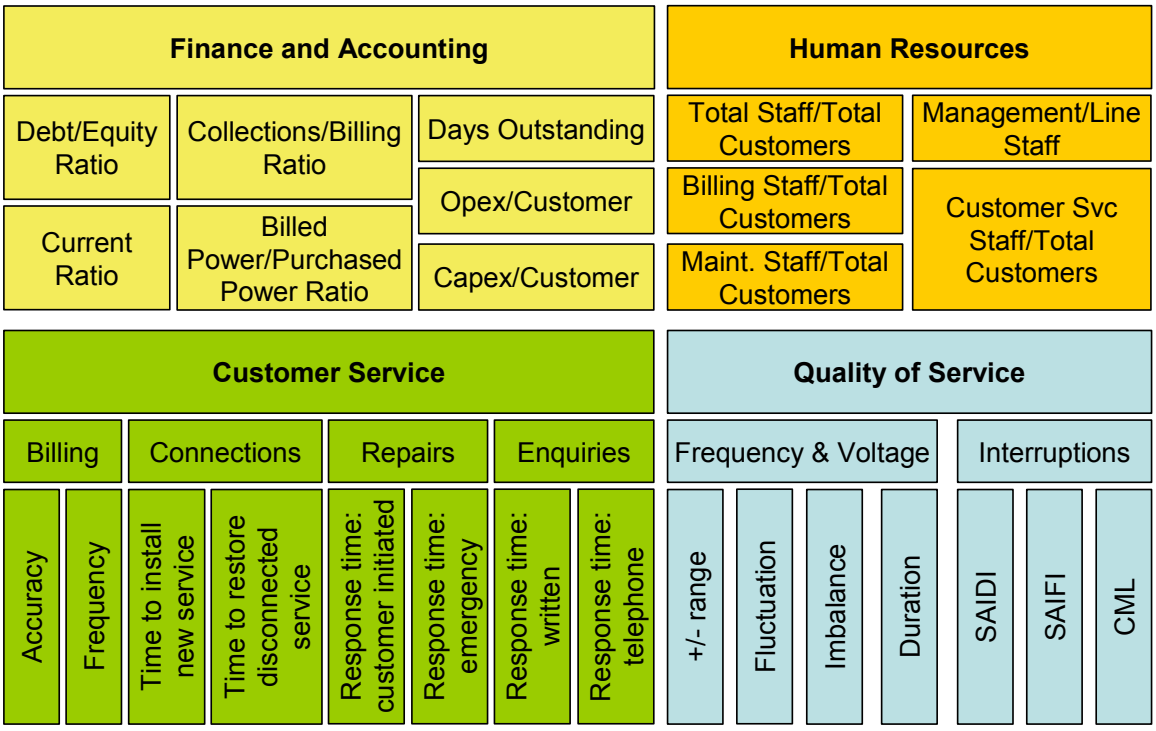
utility. They allow a utility to track progress of improvement programs and also serve as a flag for areas where service might be deteriorating and is in need of extra attention. They also allow the utility to set targets for improvement within a given year or over the course of an improvement program. In many jurisdictions, utility performance against KPIs is a key evaluation criteria used by regulators in setting tariffs. KPIs can be defined per an internal operating standard, by international standards or a mix, as is appropriate and realistic for the utility. While there is an endless array of potential KPIs that can be established, it is best to focus at first on a small, high level, high impact set of measures. This philosophy matches the approach we take with operational reforms: focus on those areas that have the highest potential for improvement, generating the highest value over the shortest period of time.

In general, there are three main categories of KPIs against which performance is measured: kilowatt-hours, people, and time. Examples of each of these include kilowatt-hours billed over kilowatt-hours purchased, customers per utility staff, and service interruptions per year. In designing KPIs, the utility should focus on metrics that cover the primary areas of concern:

- Energy 'leakages' – technical and commercial energy losses
- Billing and collections, or commercial performance
- Service quality – voltage and frequency stability, service interruptions

Examples of KPIs that are useful in initiating and sustaining operational improvements are shown in Figure 3-4. While this is not an exhaustive list, it does provide an indication of the type of measures that can be used to keep track of performance improvement progress.

Figure 3-4 – Sample Key Performance Indicators



As a utility gains experience and progress in the use of the first order KPIs, newer more refined KPIs can be added.

Use benefits to help pay for continued improvements

Using baseline measures in concert with KPIs will allow a utility to quantify improvements in operations in terms of what ultimately matters most: money. Usually, utility performance improvement programs are undertaken to alleviate or eliminate chronic deficit operations and reliance on subsidies to meet day-to-day costs of operations. While some improvements in operations are a matter of modifying employee behavior/productivity, most improvements are accompanied by some form of investment – be it meters, surveying, information technology or distribution equipment upgrades. Money needs to be arranged to undertake these investments, and, unless the money is in the form of a grant, it must be repaid. As has been stated in Chapter IV, just because a utility undertakes operational reform, it does not mean that losses will disappear overnight. It is likely that some form of subsidy or external financial support will be required for some time while the reforms are implemented and benefits begin to accrue.

But these supports do not necessarily need to be provided on a *carte blanche* basis. Performance measurements can be used to track either the savings that accrues or increases in cost recoveries realized associated with the investment. As with any investment, analysis should be done to determine whether the return on investment is positive and payback is achieved within a reasonably short time horizon. KPIs help to monitor such progress and can allow the utility to allocate progress against KPIs to dictate the rate of repayment for loans used to affect the reform.

For example, let us say a field survey along a single distribution feeder conducted in support of a geographic information system (GIS) investment yields the following results:

- Six customers without meters, stealing power
- Five customers with broken meters, two of which are commercial consumers
- Ten customers with inaccurate billing address information
- One corroded transformer in need of service

The simple act of surveying the line has yielded increased revenue by flagging meters for repair, uncovering customers that need to be regularized, and identifying required maintenance that could have led to service interruptions and/or safety issues. At the same time, the survey captured the physical location of each connection point in the electronic database and increased the accuracy of customer information. All of these will serve to increase the revenue of the utility while providing customers with an improved view of the service they are receiving. Immediately, there is a positive impact on energy loss, commercial cost recovery and service interruption KPIs. And this is achieved even before the database goes into service. Once the database goes online, there is significantly increased potential for more effective billing and collections and more efficient use of utility staff to service that particular district. Again there is a positive impact on KPIs achieved going forward. All of this results in increased revenues and decreased costs directly attributable to the GIS investment.

While the calculation of investment returns and design of financing schemes is beyond the scope of this handbook, the ability to fund capital improvements through operational reforms is an important additional benefit that can be wrought from the reform process.

Outside Help with Operational Reforms

The scale of the operational reform process can be a determinant on how or even who handles the reforms. Smaller utilities may be able to undertake the entirety of reforms in-house. Other utilities may be faced with hundreds of thousands or millions of customers disbursed over large geographic areas may find it more expedient to outsource some of the reform process. There are a number of means by which to outsource such efforts – functional outsourcing, management contracts, and microprivatization, among others – which are briefly described below. These are provided as examples of undertaking smaller scale, targeted assistance programs to help extend the efforts of existing utility staff to areas that are perhaps more difficult to undertake on the utility's own.

Functional Outsourcing
A utility can choose to outsource specific functions to private service providers in order to help alleviate some of the pressures associated with an operational reform program. One of the areas that can be outsourced is billing and billing information management. Private companies manage a customer database and are responsible for reading meters and issuing bills. This technique can be employed where utilities wish to avoid the investment required to build and maintain electronic databases but would rather pay the marginal operating cost. Investment capital requirements are transferred to the private entity providing the service. It also provides a check and balance for utilities that are experiencing a high level of corruption amongst line staff. Other areas that can be outsourced include new connections, line maintenance, and customer relationship management (particularly through call centers).

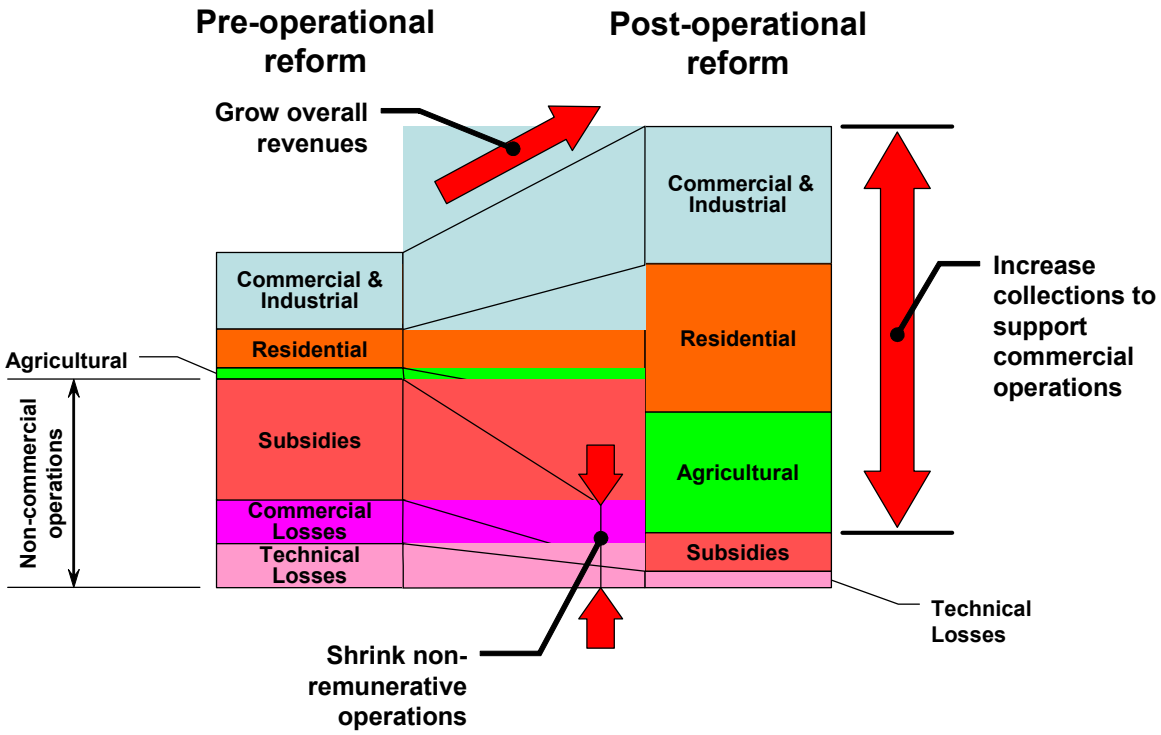
Management Contracts
The management of entire portions of the distribution system can be transferred to a private contractor. The contractor becomes responsible for billing and collections, fielding service complaints and monitoring its designated territory to eliminate illegal connections. Meanwhile the utility retains ownership of the physical infrastructure. Depending on the scope of the contract, either the utility or the contractor could be made responsible for day-to-day maintenance. Payment for such services can be done on a revenue sharing basis or, even more productively, on an incentive payment structure. Incentives are paid based on collections improvement achieved over time in relation to the baseline condition upon the start of the contract. A graduated incentive scale can be used that steadily increases the payout to the contractor for improvements achieved above a predetermined threshold.

"Microprivatization" of service areas
The ultimate step a utility can take is to completely privatize a distribution area. Depending on the number of customers and size of the area, this could be done on a feeder-wise or substation-wise basis. The franchisee becomes responsible for purchasing the power to supply customers and undertaking maintenance but also gets to reap the benefits of increased collections under a pre-arranged profit-sharing arrangement. The utility become responsible for providing electricity of a certain predetermined quality on a 24-hour basis as long as payment is timely received. The franchisee has the option of arranging for maintenance itself or contracting it back from the utility. Typically a competitive bidding process is used to determine who will take over the franchise. Price paid can be on the basis of anticipated future improvements or a percentage of the total revenue or any other financial metric appropriate for the utility. This allows the utility to transfer operating obligations of entire portions of its system to private entities that understand the risk associated with the obligation and are willing to take it on. It also permits a utility to accelerate the pace of operational reforms by leveraging the energies of financially motivated third parties.

The Outcome

In the end, the operational reform process will permit the utility to realize both improved top line and bottom line – increased revenues and the potential for earning a profit. We must stress that there is no magic panacea to create a profitable entity, but the measures described in this handbook can greatly contribute to slowing, stopping and potentially reversing loss-making practices that may ultimately reduce or eliminate the need for subsidies or deficit spending. The outcome of this process is summarized graphically in Figure 3-5. All forms of non-commercial operations – technical and commercial losses, subsidies - must be minimized, while collections need to increase and tariffs need to be adjusted to more levels that reflect, at minimum, the cost of service.

Figure 3-5 – Goals of the Operational Reform Process



Case Studies

The following sections provide examples of successful and/or progressing utility sector transformation programs from throughout the developing world.

Andhra Pradesh, India

The Indian Subcontinent has been a testing ground for major experiments in private participation in the power sector. The roots of private participation have been centered around power sector reform and an attempt to expand power service in the country. Since its opening to foreign investment in 1991, hundreds of proposals have been explored for building generation, importing fuels, expanding transmission and privatizing distribution companies. There has been a checkered history of success. Of eight "fast-track" power generation projects announced by the Central Government in 1994, only two came to fruition. Of the seven states that have

restructured their power sectors, few have progressed to the privatization stage. Only six distribution company privatizations have gone forward so far, and three of those have failed. The Indian private participation "laboratory" has many lessons that are illustrative of what can and what does not work.

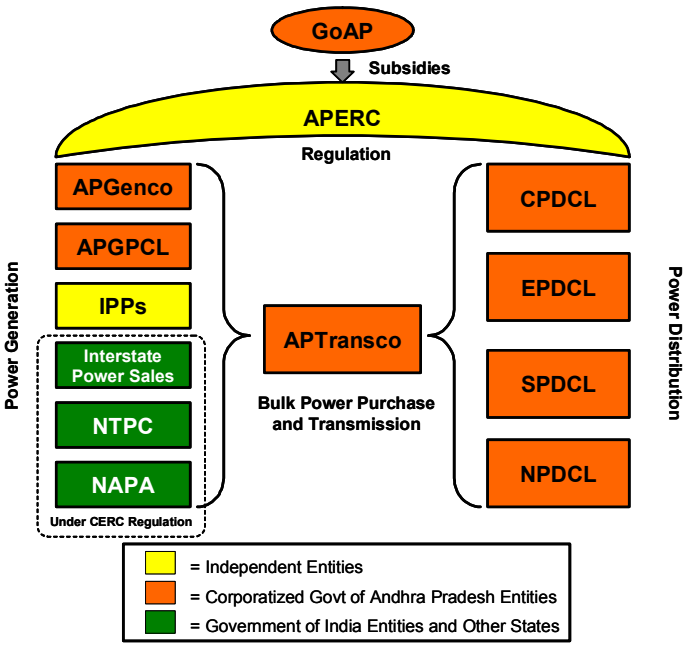
The most recent efforts in power sector reform have involved unbundling and corporatization of state-owned utilities. While the state of Orissa was the first to unbundled in 1996, home to the three failed distribution company privatizations, its progress can be described as being two steps forward, one step back. The New Delhi Vidyut Board privatization in July 2002 was an ambitious undertaking given its more than 4 million customers and losses greater than 50% of all power purchased.

Though the privatizations appear to be successful, it is too soon to tell how they will perform over the long run.

A successful unbundling program from an operational perspective, and one on which we will focus in this handbook, is the case of the restructuring of the Andhra Pradesh State Electricity Board (APSEB). This utility has followed the form of unbundling and corporatization of each component while maintaining state ownership of all entities.

APSEB was unbundled in 1999 into two generation, one transmission and four distribution companies. Ultimate ownership of these companies was retained under the Government of Andhra Pradesh, but each was given the responsibility of operating and managing itself as a corporate entity. An independent regulator, the Andhra Pradesh Electric Regulatory Commission (APERC), was also established at that time. The transmission entity, APTransco, is charged with bulk purchase of power from all generation sources, transmission to bulk power customers, and sale of energy under Bulk Supply Agreements to the distribution companies. Under the terms of the sector restructuring, APERC has granted APTransco exclusive license to supply power to the distribution companies. The four distribution companies are currently wholly-owned subsidiaries of the APTransco but, due to forward looking, disciplined governance, the distribution companies effectively function as independently managed entities.

Figure 3-6 – Reform Sector Structure: Andhra Pradesh, India



In the nearly five years since the inception of restructuring, the distribution companies have reduced their losses in aggregate by more than 33% in part through the elimination of over 2 million illegal connections. This was accomplished politically through active and disciplined support of the Andhra Pradesh state government and through financing and other support from the World Bank's Andhra Pradesh Power Sector Loan 1 (APL1) and bilateral support from UK's DfID, Canada's CIDA, and on-going support from USAID.

A number of reforms were taken at the distribution company level as part of the AP transformation program:

- Separation and restructuring of the predecessor AP State Electricity Board distribution function into four distribution subsidiaries
- Restructuring of the management and human resource structure of the entities
- Analysis and reengineering of business processes that included introduction of performance measurements and targets
- Passage of anti-theft legislation for the power sector that covered both customers and collusion of utility staff
- Formation of 'vigilance squads', separate from the day-to-day operations staff of the utility, whose sole job is to eliminate illegal connections, collect arrears from chronically delinquent customers, and investigate internal corruption. Their authority is backed up by special enforcement support from police
- Extensive consultations and communications with the public

Explicit operations performance improvement programs included the following:

- Installation of meters and data logging equipment on all 11 kVa feeder lines in order to audit supply against metered sales and to monitor for any unusual operating patterns
- Installation of nearly 3.5 million digital meters in a single year (2001); digital meters to replace mechanical meters in order to reduce incidence of tampering.
- Introduction of time of day metering on high voltage industrial customers
- Reduction of the billing cycle to one month intervals
- Instant, handheld meter reading and billing

The results of the program include:

- Inspection of nearly 5 million out of 14 million connection in one year
- Normalization of over 2 million connections
- 33% increase in revenue collected
- Arrears reduced from 60% of billings to 13% in two years
- Charging of 150,000 customers with theft of power resulting in 4,100 arrests or normalization of service

Latin America

Latin America has made significant advances in the overall reform and privatization of the power sector. In the 1980s, Chile was the first country to introduce widespread reforms to promote private participation in the power sector. The overall process of reform of the electricity sectors in Latin America materialized in several phases but has not gained enough momentum in some countries in the region – namely, Mexico, Venezuela, Uruguay, Costa Rica. In the first phase of reforms Chile was followed by Argentina in the early 1990s and shortly later by Bolivia, and Peru. A second phase of reforms spread to Colombia and Brazil by the mid-1990s. Later it spread to several Central American countries.

It is also important to note that some of these countries are now accelerating their efforts in establishing electricity markets that are regional in scope. At least three power sharing initiatives are either in operation or are in advance stages of development involving the six Central American countries (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama), the Mercosur countries (Argentina, Brazil, Paraguay and Uruguay, with Chile and Bolivia as Associate Members), and the Andean Community countries (Bolivia, Colombia, Ecuador, Peru and Venezuela). In fact significant amounts of energy interchanges are already taking place among several countries in South America (Argentina and Brazil, Colombia and Ecuador, Colombia and Venezuela), and Central America (thanks to the initiation of operations of the regional system operator in November 2002[8]).

In the Distribution segment the reform of the electricity sector has produced positive outcomes. For example, substantial increases in overall efficiency in most privatized distribution companies by cutting technical and non-technical losses, outsourcing non-core services, while at the same time providing better service quality. In Latin America the Chileans were pioneers in improving the efficiency of their privatized companies and later profited from this expertise as they participated in the privatization of many distribution companies in Argentina, Brazil, Peru and Colombia. A good example of this pattern may be found in CODENSA, the private distribution company serving Bogotá, Colombia that reduced losses from 22 percent to 10 percent, increased customers per employee from 800 to 2,000 and reduced the frequency of service interruptions and mean interruption time by about 70 percent in five years.

Central America

Prior to the reforms carried out in Central America, the experience in the region is similar to other developing country governments in the 1990's, that worldwide were spending significant amounts of money subsidizing their energy sectors, yet distribution losses often exceeded 30% (including non-technical losses such as theft). With most of the government-owned entities in weak financial condition, they were unable to raise sufficient capital to correct these deficiencies, nor did politically-oriented regulation give them the incentives to do so. As in other areas of economic policy, the solution to these problems has been to restructure the energy sector along market-oriented lines, breaking up vertically integrated companies into competing private businesses within a legal and regulatory framework that promotes economic efficiency, private investment and environmental sustainability.

Between 1996 and 1998 El Salvador, Guatemala, Panama and Nicaragua approved new Electricity Laws which created a completely different regulatory framework for the power industry in each of these counties. In broad terms these new frameworks called for vertical unbundling, open transmission access, creation of competitive generation markets, as well as the privatization of the distribution segment of the industry. The unbundling and privatization of the distribution sector in each of these four Central American countries has been completed. This process included the separation of the government-owned entity into several distribution companies and their privatization.

[8] As part of a major regional initiative sponsored by the Inter-American Development Bank an each of the six governments that agreed to create a regional market and build a transmission line interconnecting (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama).

DELSUR CASE – EL SALVADOR

Background

DELSUR, was purchased by PPL Global Inc for about US$ 180 million in 1998. At that time DELSUR had about 194,000 customers located in the south central area of the country including a part of the capital city. As of the end of 2003 the number of customers served by DELSUR was about 255,000, which represented about 25% of the total electricity demand of the country. In May 2004 PPL increased its share ownership of DELSUR from 80% to 86%.

There are six distribution companies operating in EL Salvador, four of which are private (Compañía de Alumbrado Eléctrico de San Salvador – CAESS, Distribuidor Eléctrico del Sur – DELSUR, Compañía de Luz Eléctrica de Santa Ana – CLESA, and Empresa Eléctrica de Oriente - EEO), and the other two companies have mixed capital (Distribuidora Eléctrica de Usulután- DEUSEM, and De Matheu y Cía).

Accomplishments

PPL's experience and know how in the utility business significantly improved overall management and operational efficiency of DELSUR.

- DELSUR quickly moved to improve customer service by creating a call center operating 24/7 and expanding or improving customer care centers throughout the capital city, San Salvador, to increase contact and to be more responsive to customers concerns. In this area alone, DELSUR invested over US$3.6 million during the period 1998-2002 and it included the implementation and use of information technology for customer database management incorporating historic demand consumption, billing and payment history all under a single platform.
- Another area addressed by DELSUR was to implement a program for preventive maintenance of the distribution network. Over the 1998 - 2002 period EDELSUR invested over US$9.6 million in improvements to substation equipment, distribution lines, monitoring and controlling systems, etc.

South America

The following case studies look at Peruvian utility EDELNOR and Columbia utility CODENSA. Both are success stories that have withstood the trials of economic and political changes.

EDELNOR CASE – PERU

Background

Since 1994 ENDESA (Spain), in conjunction with ENERSIS (Chile), holds a 60% interest in electricity distributor EDELNOR, serving mainly the northern portion of Lima, the capital city. They paid about $176 million in 1994 for a distribution market of about 541,000 customers. Today EDELNOR distributes electricity to about 888,000 customers.

Accomplishments

Since its privatization EDELNOR has invested over $315 millions to improve quality for service, expand the distribution network and to improve overall performance and efficiency. As of the end of 2003 productivity had reached 1570 customers per employee.

- Overall distribution losses have been reduced from 19% in 1994 to about 9% in 2002;
- Design and implementation of customer service call center (Fonocliente) open 24/7 handling more that 2.5 million call per year. Since 2001 its administration and operation was outsourced to SYNAPSIS;
- Implementation of a geographic information system (GIS) to improve operation of the network. EDELNOR's primary, secondary and public lighting networks are managed with 4DataLink software. Primary networks are both schematic (for the Operations Department) and geographic (for engineering projects), and 4DataLink ensures consistency between both models. The system interfaces on line with the billing system (Synergia from Synapsis), the call center, the company's SCADA system and other technical systems. EDELNOR's 4DataLink implementation won the National Award for Technological Innovation in Peru during 2000.

CODENSA CASE – COLOMBIA

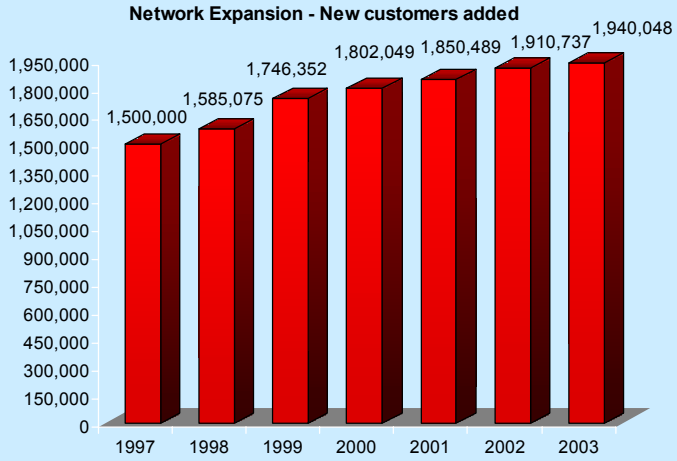
Background

Codensa was created in 1998 when the vertically integrated utility (EEB) serving Bogotá was unbundled and privatized in three separate companies: EMGESA (generation assets), EEB transmission (transmission assets), and Codensa (distribution assets). Codensa was privatized using a capitalization model where Enersis (Chile) and ENDESA (Spain) invested about US$ 1,226 for the distribution market covering the capital city, which represented about 22% of the total demand.

Accomplishments

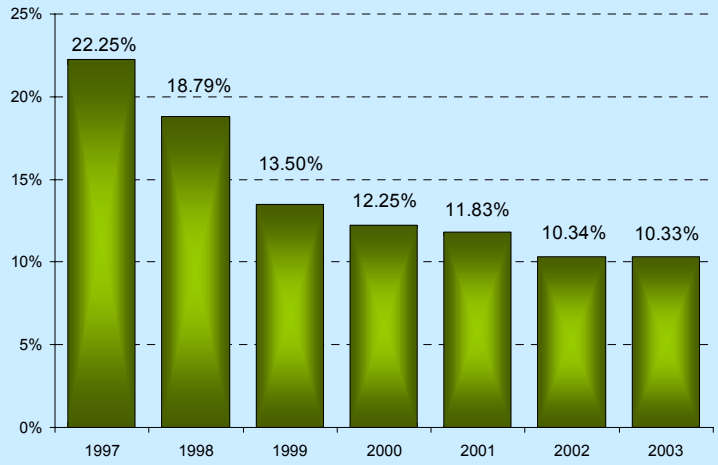
The restructuring process of CODENSA in Bogotá was completed on time and with no cost overruns, allowing this distribution company to reach a productivity level of 2,100 customers per employee. Downsizing programs have been offset by contracting-out a variety of services associated with network expansion and maintenance, information technology, and installation of metering devices.

- Average interruption time was reduced over 70% from 6.3 hrs in 1997 to 2 hrs in 2002;
- Average of interruption frequency was reduced over 70% from 11.4 in 1997 to 3.11 in 2002;
- Since 1998 Codensa has invested over $US200 million in programs to improve quality of service, expansion of the network, and improve overall efficiency in corporate management;



Improving the network

- Since 2001 Codensa has implemented a program to replace and inspect meters. About 200,000 meters have been replaced at a cost of over $US 9 millions; and over 800 neighborhoods with illegal connections have been converted
- Overall distribution losses have been reduced from 22% in 1997 to about 10% in 2003.



IV. A Programmatic Approach to Operational Improvement

The process of transforming a utility into a commercially viable entity cannot be done piecemeal; rather it must be approached holistically – holistically designed, holistically implemented, holistically managed, holistically funded. Operational improvements should be undertaken as part of a broad program of reform. Changes cannot be made in isolation; often adjusting one part of operations has a cascading effect on other parts. Certain improvements can require extensive capital investment while others can be achieved merely through reorganizing work processes. Some improvements are dependent on preceding changes while others can stand alone. Some improvements serve to refine performance while others have order of magnitude impact.

A structured and prioritized approach to operational reform is needed in order to create sustainable, achievable and demonstrable success. Tackling the process in a random or haphazard fashion may not produce the results stakeholders seek and may actually damage the reform process by creating a crisis of confidence. In this chapter we propose a prioritized approach that focuses initially on what we view as prerequisite activities to implementing reform. Once those elements are in place, we encourage emphasis on high value, low effort "quick wins" not only to demonstrate the efficacy of operational reforms but also to generate a significant level of savings that can be used to fund further operations improvements. Also, since "success breeds success", the gains made encourage managers to make continuous improvements.

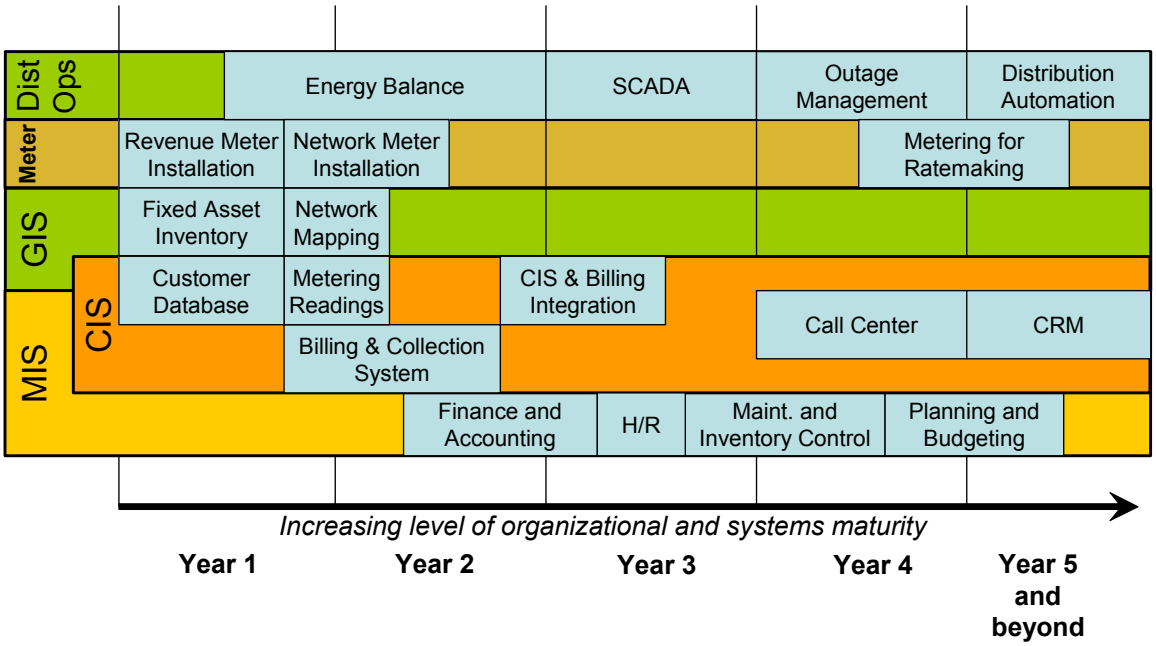
This programmatic approach seeks to help management and planners sort through the possibilities and outcomes by focusing on three areas: 1) how to prioritize the specific actions taken to improve operations, 2) how generally to organize the approach, and 3) how to manage the program from the top down. These aspects must be linked in planning any transformation process, particularly for large utilities. While the first item – the specific actions, like upgrading meters or building a GIS – is readily seized upon by planners, the second portion – how to roll out these improvements – is equally important. Implementation parameters, such as which geography to start with and which customers to initially target, have a tremendous impact on both the initial success of the improvement program and the ability to continue the improvements. The third element – top level management oversight – is often completely ignored, to the detriment of the entire improvement process.

Roadmap to Operational Reform

There is a priority and hierarchy of efforts recommended to enact effective operational reforms. Based on experience, the best means for utilities to address performance issues is to first build accurate knowledge of their system and their customers. The next step is to measure the performance of the system, both technically and commercially, in order to identify the highest areas of loss and/or readily addressable problems. As the highest value, easiest to address areas are rectified, reform efforts can become more targeted and refined. As one proceeds further along the timeline, there is inherent a growing maturity of the systems, the management, and the personnel using the systems. This maturity allows the utility to undertake either more complex or more refined improvement tasks.

One recommended progression of operational improvements is provided in Figure 4-1.

Figure 4-1– Recommended Progression of Operational Improvements



A programmatic approach to operations improvement is a must for utilities looking to efficiently and effectively change. Process changes and investments in one area should be complementary and build upon changes already undertaken or to be undertaken in the future. A simple example of the complementary nature of a performance improvement program could be:

- Building a customer database is supported by network mapping
- Network mapping supports determination of which areas to install new meters
- New meters permit help to regularize connections and help to institute a new meter reading, billing and collection scheme
- All of this data taken together helps to populate a CIS database

It should be noted that these elements can be interchanged without dramatically impacting the ultimate outcome. Each utility should examine objectively in which areas they are most deficient and, more importantly, objectively assess how lack of progress in those areas impacts operations. While lack of a GIS may hamper the ability of the utility to monitor and improve its network, if a utility could greatly improve its operation simply by changing the way it delivers bills to customers through a manpower reshuffling, this latter improvement should be enacted first. If this helps to immediately improve percentage and timeliness of collections, it should be prioritized, especially since it is a low cost, high return action.

Out of the performance improvement options highlighted in Figure 4-1, this handbook provides introductions to energy balances, metering, billing and collection systems, construction of customer information systems, overall management information systems, and methods to improve cash collection efficiency. These are areas where utilities can almost universally yield

large scale improvements, often without major capital investment. Topics not covered herein often require significant investment and/or level of maturity within the operational reform process.

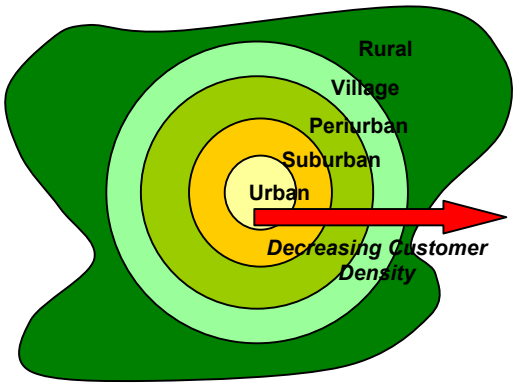
Prioritizing Reform Efforts

It is imperative that utilities prioritize their implementation efforts when undertaking operational reforms. This permits the utility to focus first on efforts that yield the highest value with the lowest investment and are realized over the shortest timeframe. Prioritization creates the potential for initiating a self-sustaining chain of improvement that simultaneously silences critics by delivering tangible, measurable benefits. There are three key, high level parameters upon which to focus in setting priorities: geography, number of customers impacted, and the per-customer value of the reform.

Prioritizing Operational Reform Efforts:
- Geography
- Number of customers impacted
- Per-customer value of reforms

It is easiest to focus first on service territory areas that have the highest density of customers; typically these are the urban areas. A district-by-district approach can be taken which eases logistical efforts while providing high visibility of the results. As the improvements take root, they can then be progressively rolled out further from the urban core (see Figure 4-2).

Figure 4-2– Geographic Prioritization



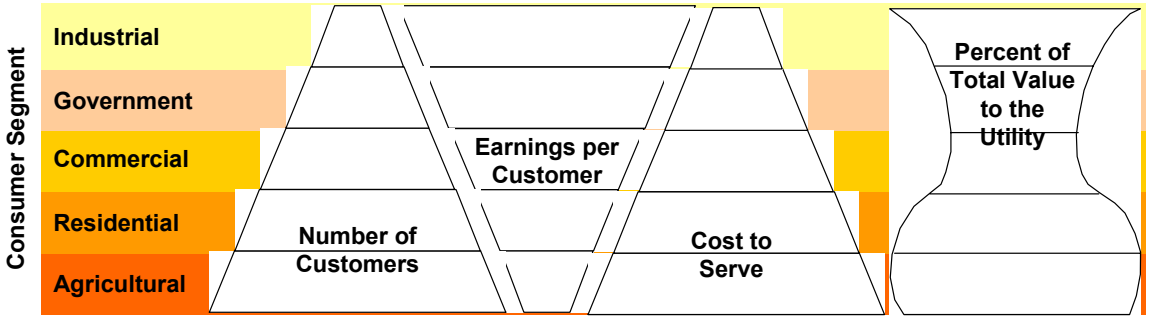
Next, it is better to initiate reforms with the customer class that has the highest potential value or return on the reform investment: this is typically the industrial customer. There is the added benefit that there are comparatively few industrial customers, thus helping to minimize the scope of initial reform efforts. By improving billing and collections efforts at the industrial level, the multiplier effect is usually larger providing high impact (see Figure 4-3).

One customer class that should be the target for reforms is the government sector. In many developing countries the government sector is one of the most recalcitrant when it comes to paying its dues. Often government agencies feel that since they, albeit indirectly, are the owner of the utility and further that the government provides subsidies to the utility ("their money"), that it is entitled to "free" power. A government that is serious about creating a commercially self-sustaining utility must look at itself first and set the books straight. This is a reform that has broad ranging impacts. Forcing government entities to pay for their power has the unanticipated result of making transparent the operating overhead costs of that entity. For many, this will be the first time that the government entity would have to explicitly budget for utility services. But the impact of seeing government "practice what it preaches" is far-reaching. It demonstrates how seriously reforms are being taken and will encourage consumers to follow suit.

Over time, the reform program can expand from industrial consumer, through government and commercial to residential customers within the urban area. As these efforts are completed, the

program can then expand geographically to areas further from the urban core following a similar customer progression.

Figure 4-3 – Prioritization of Operational Reform Efforts by Customer Class



Note: This is illustrative only. Distribution of customers over classes, earnings, cost to serve and allocation of value amongst customers differs greatly from utility to utility.
In this example, the small number of industrial customers contributes a great deal of value per customer. This particular utility has a significant government load for which they charge a premium. Also, uncharacteristically to most utilities, their commercial customers do not provide significant value to the utility, but the large number of agricultural customers, though difficult to serve, could be a significant value contributor if they pay.

At the outset of operational reform programs there is often significant resistance from many of the primary stakeholders – customers, utility staff, and government officials. Often the arguments against such reforms are that customer rates will increase to unaffordable levels, service will deteriorate or there are insufficient funds to undertake such work. A properly prioritized program will target the highest value, easiest to attain areas first in order to allay or dispel such concerns. At the other end of the spectrum, the worst possible approach would come from tackling an area that is capital intensive, takes a long time to implement and benefits only a small portion of the stakeholders. Working on a value and effort hierarchy basis has the added benefit of creating savings early on that can potentially be used to fund further refinements of the system or shared with the customers. The key to both is properly measuring the benefits that arise from operational reforms and broadcasting the results to the stakeholders. This is covered in more detail below.

Holistic Management of the Improvement Process

There are areas that are instrumental to a performance improvement program's success, visionary, actively involved senior management and access to funds to make the program happen. Without either, change will be incremental, disjointed and potentially unsustainable.

Holistic leadership
Performance improvement cannot be a task that is simply delegated to middle management, particularly at the outset of a program. It should be made to be the number one priority of the CEO. Given the breadth and depth of impact the projects highlighted in this paper can have on the utility, it is difficult to imagine how the CEO could have anything other than performance improvement as his or her top priority. The programs proposed in this paper touch every area of operations and investment within the company, thus requiring, at minimum, senior management oversight, but preferably leadership. With the CEO presiding, the other officers of the company, including particularly the Finance Director and Chief Operating Officer, must promulgate just how serious and important the performance improvement program is to the utility.

The senior management should also be responsible for coordinating and planning each step in the performance improvement process. The view from the top is necessary to direct all of the interlinked performance improvement measures, since they cut across technical, human resource and back office disciplines. Only senior management can make these disparate groups work together, coordinate and share data. A vision of the master plan and monitoring of improvements through performance indicators will permit management to refine the program, shifting emphasis and resources to program elements in need. The success of restructuring and reforms in Andhra Pradesh, India was derived directly from the installation of professional management who took a hands-on approach to improving operations, supported by a visionary government that allowed management to work unhindered while providing the legal backing needed to affect change.

The following outlines the key principles management should consider when developing and leading and operational change and improvement program:

- **Strong leadership will be the catalyst for change.** Management must believe in change and lead it. 'C-level' executives (CEO, CFO, COO, etc) should plan, discuss and monitor performance improvement above all other items on their agenda. There needs to be recognition that the utility is the problem, and management need to tirelessly focus on it.
- **Senior management must develop and lead the change program.** A holistic view of the operational improvement program must be taken; only executive management can create the corporate vision and see that it is implemented. Further, only executive management can assure adequate human resources and capital are allocated to the effort. There can be no devolution of change *leadership* responsibility to lower levels. Operational reform, particularly a rapid transition to commercial-minded performance, should be executive management's *top* priority.
- **Senior management must be accountable for results.** Senior utility management need to take firm control of the day to day operations of the business. They must accept full accountability for utility performance – service-wise, technically, and fiscally.
- **Management should solicit feedback from staff and customers.** Management needs to re-connect with its line staff and pay much more attention to daily operational issues for that is the place where problems initially occur and accumulate. Bottom-up feedback should be solicited and encouraged from line management and staff since they live with operational problems every day. Customer feedback should also be actively solicited; customers are more brutally honest about where improvements should be made.
- **Management and staff need to accept that an operations improvement program is a permanent process.** There is no end date to an improvement program. It should become an inherent part of utility operations and management. Management must establish, understand, and review performance metrics continually to assure the company is on the correct course. If management embraces the metrics and make promotion and staffing decisions based on it, employees will become similarly concerned about performance against those measures thus reinforcing the overall program.

Holistic view toward funding

Development aid institutions have a long history of supporting the emerging market utility sector. Recently, the universe of funds available to the emerging markets has expanded to include a greater variety of investment funds. There are now myriad sources of capital available from multilateral, bilateral, private, and domestic government sources. There are commercial lending entities willing to participate in development assistance on a co-financing basis. There are debt

and equity funds established by development oriented private and public-private partnerships looking to support energy sector investment. These need not be competing sources, but complementary. From the utility's perspective, being tied to one program or one course of action may not allow the utility to achieve as thorough or complete a change as possible.

With so many sources of funding available under various terms and conditions, commercializing utilities should attempt to pool and manage these prospective resources on a portfolio basis. For a progressive and reform-minded utility, managing such sources of funding can be a full time job. One of the key roles that could be undertaken directly by or under close oversight by the Finance Director is a development assistance capital management function. This position serves two equally important purposes: identifying sources of capital and managing outstanding loans.

Once development assistance is secured, it has become extremely important to service this debt and/or provide a return on investment. Waning are the days of straight grants or 'no strings attached' lending. It becomes a priority for utility finance directors to monitor overall utility financial performance against metrics and targets agreed with fund providers. Reporting to lenders and investors is an important function that permits fund providers to continue their investments in confidence. Good funds management by the utility also creates its own marketing by signaling to the capital market that the utility is a good risk, making it more likely that it will receive future funding, potentially on easier terms than before. Accordingly, the reporting function should be managed by the utility's finance director.

It is also important to note that many development aid agencies are evolving their offerings to drive more commercially based investment decision making and operations. There is a strong trend towards requiring elements of co-financing or complementary financing that blend foreign and domestic sources of funds, multilateral and commercial sources of funds, or leverage internal funding resources of the utility. With this change comes much more stringent requirements for performance and reporting. Utilities should not fear this sort of accountability; if their performance improvement program is properly planned, managed, and monitored using key performance indicators, the supporting information lending institutions require should flow from the utility as an ordinary part of operations. Nonetheless, it is important to make certain any restructuring or improvement program is accompanied by appropriate metrics. The utility should work with lenders to establish a clear baseline starting point for the program then measure improvements as the program progresses.

In summary, it is important for utilities to take seriously both the sourcing and management of capital support. Leadership of the utility's finance director is imperative to assuring that the maximum amount of funds are made available to complement other sources of capital and support reform, growth and improvement efforts.

V. Energy Network Balance and Accounting

A network energy balance of a distribution utility measures the differential between the energy input into the system and the energy received by the customer, and attempts to account for all energy used, sold, and un-accounted for in distribution. The balance can be performed a portion of the system or on the entire system. An energy balance may be considered similar to the balance sheet of an accounting system. One series of entries shows the quantum of energy received from each source – i.e., generator or purchase point – and another series of entries shows the energy sales to customers for residential, commercial, industrial, and irrigation purposes, and technical and commercial losses. The energy balance process must be accurate enough to identify and qualify utility investments that will reduce energy losses, and quantify expected cost savings from such investments.

This chapter covers the following topics in order to fully examine the energy network balance and accounting of a utility:

- Importance/ Relevance of Energy Balance
- Types of Utility Energy Balances
- Energy Balance Requirements
- Implementation of Energy Balance
- Case Study

Importance / Relevance Of Energy Balance

Many developing countries recognize the importance of the utility energy balance to justify and plan programs to transform utilities into commercially viable entities. The balance methodology assumes great significance where the average total energy loss is estimated to be significant, and consist of technical and commercial losses. Technical losses are those that occur due to energy dissipation in the conductors and equipment used for distribution of power due to their inherent physical characteristics. Commercial losses are those that are attributable to pilferage of energy, poor quality energy meters, defective energy meters, or errors in meter reading and billing. The international norm is generally considered around 8% for technical losses (depending to a great extent on the voltage level at which energy is delivered to the various classes of customers), and 2% for commercial losses. High technical and commercial losses are one of the major contributing factors for poor financial health of power utilities and need to be addressed as a top priority. An energy balance is an effective tool for identifying the network elements responsible for technical losses, and the customers or group of customers responsible for commercial losses.

Types of Utility Energy Balances

Utility energy balances can be broadly classified into five categories, based on power system hierarchy and increasing order of detail/complexity:

- Utility balance
- Area / district balance
- Feeder balance

- Transformer balance
- Customer balance

The utility balance is least costly, and customer balance is most expensive. There is a direct relationship between the cost of balance and the number of energy efficiency opportunities that can be identified. This is due to the amount of data that the utility must collect and analyze.

Utility Balance
This type of balance provides the utility with only macro level information – energy input to the utility, total energy billed and total losses. It identifies the global energy efficiency status and the potential for energy savings.

Area Balance
Generally, an area chosen for energy balance is a utility administrative unit comprised of one or more substation service areas. This type of balance requires identification of energy input points to the area, and metering of these points to estimate energy input to the district or area. It also requires the computation of energy sales in the area. This balance determines the areas to be concentrated on for energy savings.

Feeder Balance
This balance helps to identify the feeders responsible for losses within a given area. It evaluates how much energy is input into each feeder, how much is billed to the customers, and the magnitude of technical and commercial losses. The balance requires metering of each feeder, and customer indexing or identification of all customers served by the feeder.

Transformer Balance
This balance helps to identify the transformers or small service areas that contribute to losses along a given feeder. To perform the balance, the utility must meter each transformer to determine the quantity of energy input and aggregated to customer's bills. This allows the utility to compute the quantity of energy sold to each customer served by each transformer.

Customer Balance
This is the last mile balance in the hierarchy and identifies the actual customers responsible for commercial losses. This is accomplished by classifying customers into a set of groups based on their energy consumption patterns / characteristics and then comparing the energy sales of customers in the same group.

Energy Balance Requirements

The minimum data requirements for performing a utility energy balance are as listed below.

- Information on energy resources or import points through which energy is received into the power system under balance, and energy export points through which energy is sold or exported outside the power system under balance.
- Install sufficiently accurate energy meters to measure the energy import and export.
- An accurate map of the network indicating the distance of each feeder or feeder segment, with conductor size and configuration. The map preferably should show physical disposition of network with surrounding physical features.

- Asset database showing technical particulars of lines and equipment to determine characteristics responsible for technical losses like resistance, reactance, no load losses, full load losses, etc.
- Network profile which enables the utility to identify which customer is incident on which transformer or feeder dynamically as the network configuration changes.
- Customer master data, giving customer number, address, tariff category, type and accuracy of meter installed, connected or contracted load, etc.
- Customer classification into a set of classes based on the purpose of usage, level of usage, etc., for performing customer balance.
- Customer billing data detailing energy meter reading, energy sales, amount billed, amount paid, etc., as per billing cycle.
- Estimated energy sales to the customers who are charged on a fixed rate basis and to whom meters are not provided.
- Estimated technical losses in the network by using load flow analysis techniques.

As-is / Where-is Situation and Road Ahead

Utilities perform energy balances to get an overview of the status of the total losses in the system and the opportunities available for energy efficiency improvement and energy savings. The district balance is performed in very few cases. Other types of balances, such as feeder balance, transformer balances, and customer balances are seldom performed as the data requirements for these balances is not readily available. Without performing a feeder balance first, the transformer balance and customer balance cannot help to identify the losses. Therefore, a utility should first review the current status of data availability for performing an energy balance.

Identifying Energy Import-Export Points to the Power System and their Metering

This task of import-export point identification may be a significant concern for performing the utility balance, as the points may not be clearly identified or well metered. The identification of import-export points is a detailed exercise with respect to the district area balances. The availability of sufficiently accurate meters at import-export points is a matter of serious concern for all but utility balances. Most often, even if meters are available at the import-export points, they are of very poor quality do not have the required capabilities.

Desirable Meter Features

The desirable features of meters placed at import-export points are presented below. It is recommended to utilize electronic tri-vector meters with the following characteristics:

- 0.2 class accuracy
- Load survey capability
- Remote metering capability with RS 232 / RS 485 ports

Class of Accuracy

When selecting the class of accuracy of the meters to be installed, utilities must consider the number of metering points and energy being handled so that the standard deviation for a normal distribution of errors is in accordance with international standards. As per this class, 0.2 accuracy meters are required for generation and EHV level, class 0.5 is required for accuracy at sub transmission level, class 1.0 at primary distribution level, and class 2.0 at secondary

distribution level. In sum, the suggested metering plan for energy accounting and priority for implementation is indicated in Table 5-1 below.

Table 5-1– Meter Features and Accuracy

Sub System	Meter Type	Meter Class of accuracy	Meter Features
Supply input points to the utility	Electronic	0.2	Load Survey capability i.e., logging of kWh, kVArh etc., every 15 minutes for 40 days.
Supply input points to the district	Electronic	0.2	Load Survey capability
Every 11 kV feeder from 33 kV & 132 kV substations	Electronic	0.5	Load Survey capability
Selected Distribution Transformers	Electronic	1.0	Load Survey capability

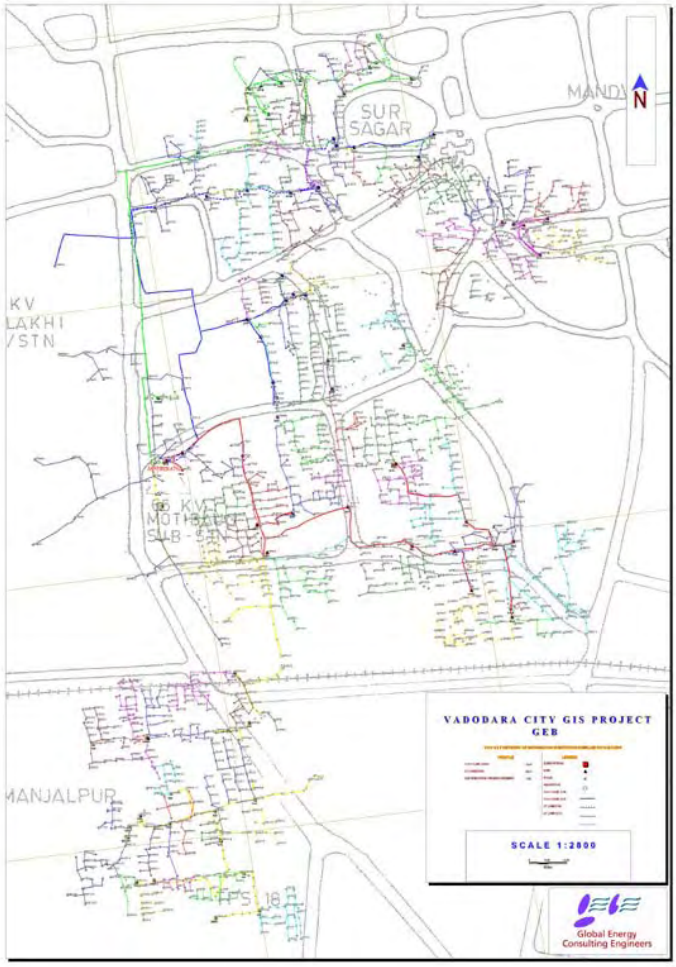
Network Map

A majority of the utilities in the developing world do not posses sufficiently accurate network maps and, if available, have not been updated for many years. In most Indian utilities, network maps of the low voltage distribution system are not available at all. While for the high voltage distribution system there are single line diagrams of the network, or network maps drawn on state government maps there is no validation to assure their accuracy.

If a utility seeks to conduct an accurate energy balance exercise, they must create a database of the network maps, and unfortunately, there is no take off point. The entire process of generating maps has to start from scratch, i.e., surveying the network to uniquely identify the position of each element in the network and their inter-linkages.

In Figure 5-1 below we present a typical area map depicting the network as available prior to conducting a mapping survey (shown in red color), and after conducting a systematic and thorough survey (shown in blue color)

Figure 5-1– Sample Network Map, Vadodara, Gujarat Electricity Board, India



Asset Database

Asset registers are generally not available, and are incomplete and outdated where they are available. Conducting an energy balance exercise requires an exhaustive set of details on the assets, including technical particulars, condition of the assets, etc. The network survey will provide for the position of the network elements and the distances between them, i.e., the configuration of the network. The utility requires an asset survey if the facilities available on the network and their characteristic features are to be known.

A utility can further appreciate the importance of the asset database by examining some typical cases. On field energy balances, the technical losses that accrue due to the distribution transformers are much higher when compared to manufacturer specifications. This is due to the frequent failure of poor quality transformers in regular need of repair.

Customer Indexing

This information is of prime importance for performing feeder balance, transformer balance. Customer indexing contemplates tagging customers with a relevant asset of the utility, enabling

network map identification of the customer. The last mile of the network servicing a customer is either the service pillar, in case of cable distribution system, or pole, in case of overhead distribution system. Hence, for each pole in the utility, the connected customers are enlisted and tagged to that pole, forming a customer database.

Customer Master Database
Customer master data provides the customer name, service connection number, address, meter number, service connection release date, deposit amount paid, etc. Utilities generally have this information available in databases or sometimes only in paper form. An energy balance requires this data to be available in an accurate and readily retrievable form. Hence, if this information is not available on computer systems, it must be collected and input into the system to create a customer master database. This process should also include checking and validating the information with respect to duplication of service connection numbers i.e., more than one number for the same consumer, etc.

Customer Billing Data
For each billing cycle of a consumer meter reading, Customer Billing Data provides data on consumption, amount to be paid, the bill number, the payment date and receipt number, mode of payment, etc., which is generally available in a computer database. Some utilities, only have such date in paper form. As in the case of customer master data, the billing data should also be accurate and available in a readily retrievable form. This calls for collecting the information and inputting the data into a computerized system, along with checking and validating the information.

Customer Classification
Most utilities classify customers based on the prevalent tariff categories. A customer classification based on the purpose of their power supply and their consumption pattern would be more helpful for conducting an energy balance exercise. For example, if we consider the power consumed for lighting in a hotel, a jeweler's shop and a photo shop, the quantum of electricity consumed in the hotel will be much higher than in the jeweler's shop, and even higher when compared to the photo shop. However, most utilities generally classify all of these as commercial customers. Even if the jeweler's shop and the photo shop are compared, a jeweler's shop will keep all lights on continuously, while in a photo shop most lights are switched on only while taking a photograph. Thus, the consumption of different consumers differs within a category depending upon the nature of their business and purpose of power supply.

Energy Sales to Un-metered Customers
A number of utilities do not meter the consumption of certain customers and instead charge a flat rate. For example, in India, most utilities do not meter irrigation pump sets and residential houses of economically poor customers. The measurement of energy sales to these consumers with adequate accuracy plays a crucial role in energy balance and accounting. Typically, energy sales to un-metered customers is estimated by providing sample meters to selected consumers at random and projecting the consumption for the total population. However, this does not adequately reflect the consumption patterns of the un-metered consumers. In fact, the reform process in India has revealed that a number of utilities boost energy sales figures to un-metered consumers in order to show lower energy loss figures. Instead, utilities should address this problem by providing meters to all consumers whether they are charged on the basis of metered consumption or not. Until this is done, utilities should estimate energy sales using stratified sampling techniques.

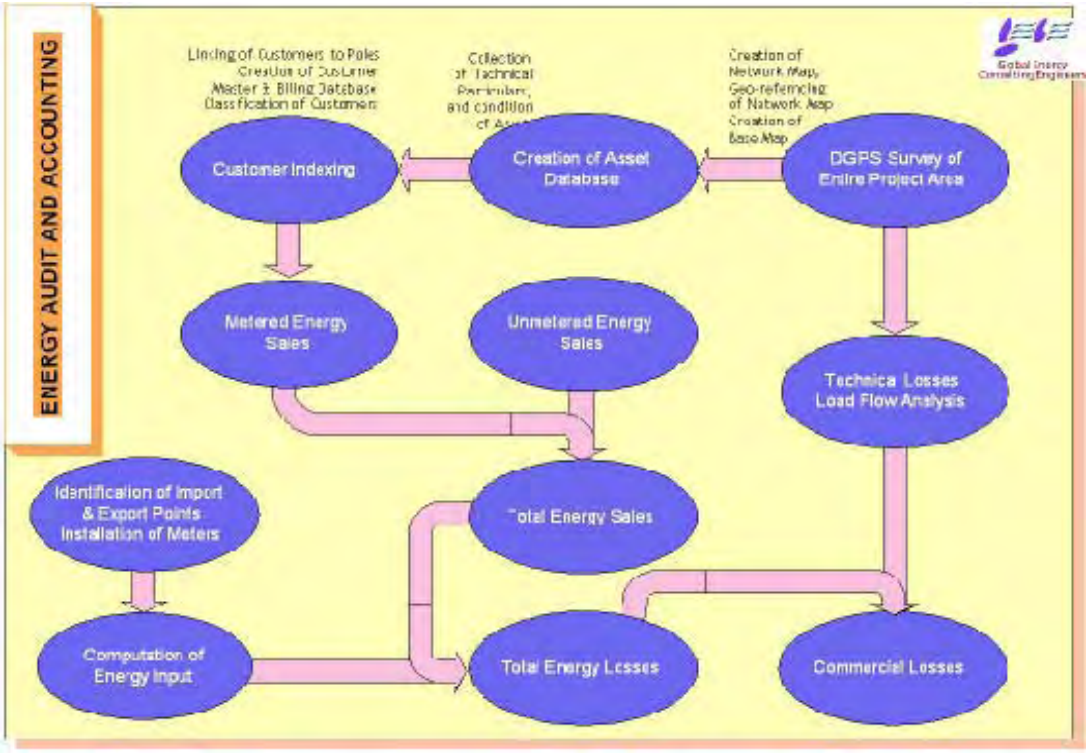
Technical Losses

The difference between the energy input and energy sales / output equals the total losses. The total losses comprise both technical and commercial losses. In respect of 33kV and higher voltage networks, the commercial losses should be considered nil since few consumers avail power supply at that voltage, and they can be watched effectively to prevent commercial losses. However, with respect to 11kV and LV networks, the losses have to be segregated as technical and commercial losses. The best way to estimate technical losses is to perform a network load flow analysis. The important requirements for load flow analysis are accurate digital maps of the network, load data, and distribution equipment ratings. As already stated, where network maps are not available, the technical losses cannot be estimated with reasonable accuracy. A utility can effectively address this problem of technical loss estimation once it has completed the network map and compiled asset data as proposed above. Another hindrance to estimating technical losses is the lack of application software availability. The utilities will need to equip themselves with the application software and train the utility personnel to run the programs.

Implementation of Energy Balance

The implementation process for energy balance depicting the important sub processes is shown in Figure 5.2 below.

Figure 5-2 – Energy Balance Implementation Process



This process can be executed in two stages: the first stage creates a Geographic Information System (GIS) encompassing the network map, asset database, customer indexing, customer database; and the second stage deploys the EAA system and trains utility personnel.

Network Map
The stepwise process for generating accurate network maps and creating a network database follows. This requires a survey of the utility network using state-of-the-art Global Positioning System (GPS) techniques. Though different technologies exist for surveying, like the theodolite survey, walk-over survey and GPS survey, the state-of-the-art and most advanced is the GPS technology. This technology is preferred since each facility in the network is identified uniquely by its latitudinal and longitudinal position on the earth. Since the latitudinal and longitudinal positions are unique, the location of the facility is also uniquely identified.

GPS Technology
A survey based on GPS technology provides directly latitude and longitude of the location of asset on the ground. There are wide ranges of GPS receivers with accuracy ranging from 100 meters and above, to the centimeter. The price of instrument also ranges from US$100 to US$100,000. The instruments widely used for GPS survey of power distribution networks have an accuracy of 5 meters on stand-alone operation, and 1-meter accuracy on differential mode.

Principles of Operation
GPS technology is based on measurement of the distance of the position of GPS rover/ receiver on the earth from a group of satellites in space known as satellite ranging. The U.S. Department of Defense (DOD) operates a group of 24 GPS satellites orbiting at approximately 20,000 kilometers above the Earth. These satellites complete two orbits per day, providing 24 hours GPS coverage for any location on the Earth; signals are available to all users across the globe at no cost. A GPS rover unit is taken to every electric utility point to determine its latitude and longitude. The positional fix at the asset is summed and averaged for 30 seconds. Figure 5-3 shows the GPS satellites' method of measurement.

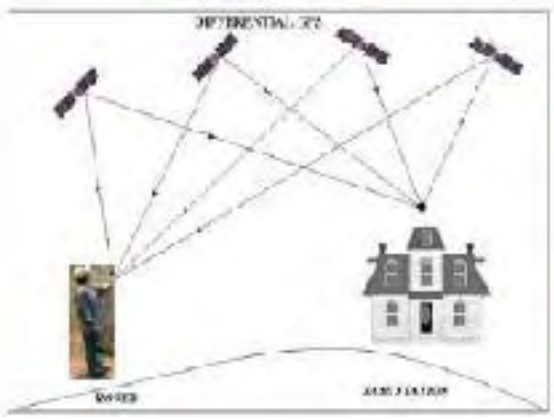
Figure 5-3 – GPS Satellite Positioning Process

Differential GPS Technology
The accuracy of measurement by a stand-alone GPS receiver ranges from 10 meters to 100 meters. To obtain the one-meter accuracy required for utility mapping, the differential GPS mode is used. The differential mode contemplates establishing a base station with the installation of one, 12-parallel channel receiver to collect the data at a base station. GPS data is collected at one-second intervals for the whole period of the survey. A rover unit is taken to every electric utility point to determine its latitude and longitude. At the end of the day, the data

collected in the rover is transferred to the base station computer for differentially correcting the data with respect to the base station logging. This process is called differential correction by post-processing. This is necessary to obtain a positional accuracy of the electrical utility within one-meter accuracy. Figure 5-4 shows the rover and base station and Figure 5-5 shows the differential mode of correction.

Figure 5-4 – Rover and Base Station

Figure 5-5 – Differential Mode of Correction and GPS Survey



Comparative Advantages of GPS Technology

GPS based mapping is the state-of-the-art technique for creating digital maps. This technique is being adopted the world over not only for utility mapping, but for various other activities, like construction of oil and gas pipelines, underground tunnels, etc. The importance of this technique stems from its distinctive advantages over other techniques:

- Notably faster.
- Survey is not limited by direct visibility or/and weather conditions.
- Enables collection of attribute data along with location position.
- Data accuracy is much more precise.

- Survey provides location in geographic co-ordinate system, which is unique; whereas other surveys provide location in local co-ordinate system, requiring geo-referencing the maps.
- Productivity of the survey is excellent since it produces a map of the surveyed points along with all its attributes in digital form.
- GPS data is portable to GIS packages for creating a digital map and spatial distribution analysis.

Creation of Base Map

- The utility personnel can effectively use the network map generated using the GPS survey only when network elements are identifiable relative to the geographic and topographic features of the network area. The process flow for creating a base map is presented below.
- Procurement of satellite imagery with resolution equal to or less than one meter, like IKONOS or Quick Bird.
- Geo-reference the image by taking the latitudinal longitudinal position of a sufficient number of identified points using GPS software.
- Digitize the satellite imagery using GIS software.
- Survey latitudinal and longitudinal positions of important landmarks not clearly identified in the image using GPS software.

Asset Database

An asset database provides for exhaustive information on all assets incident on a network, along with their technical and maintenance particulars. The information that needs to be collected from the utility to build an asset database is listed below:

- Record technical particulars for each asset, like the code, name of manufacturer, year of manufacture, installation date, location name, etc.
- Track the life cycle of each asset starting from its procurement to its retirement / scrapping, and maintain all historic information of both assets in use and scrapped assets.
- Store maintenance information of all assets with relevant details like the type of maintenance works to be carried out, their timing, etc.
- Record inspection details of assets and inspection test results to determine the performance and quality of the assets.

Customer Indexing

This task envisages mapping each customer on to the network map, and identifying the exact location of the customer and the network elements associated with providing their power supply. Furthermore, the network database must be linked with the customer database, thereby facilitating access to the customer's metering and billing data. The following process flow diagrams illustrate the approach for mapping customers onto the digital network maps, and linking them to the billing databases.

Estimation of Energy Sales to Un-metered Customers

A rational approach to arrive at a reasonably accurate figure for the consumption by un-metered consumers is presented here:

- Identify the causal factors responsible for energy consumption

- Stratify the customer population into a set of classes based on the causal factors
- Select a fixed percentage of customers in each class at random
- Provide metering for the selected customers
- Extrapolate the consumption of selected customers in each class to the total population in that class
- Aggregate the consumption of each class to arrive at the total consumption of un-metered consumers

The nuances of estimating energy consumption by irrigation pump sets in India are illustrated. The energy consumption of irrigation pump sets depends on three factors: number of pump sets, capacity of pump, and number of working hours in a year. Of the three parameters, the power utility maintains data on first two. Unfortunately, these figures are inaccurate, and in most cases, grossly underestimated, since there are number of unauthorized pump sets availing supply, and the capacity of motor is increased by farmers over the years due to the lowering of the ground water level.

The third parameter, number of working hours in a year, is dependent upon the following factors:

- Area irrigated
- Type crops grown, i.e., rice, sugarcane, dry irrigated crops
- Depth of groundwater availability
- Number of crops grown
- Yield of well
- Rainfall in the year
- Type of soil

The above casual factors vary widely from well to well and season to season. The database on these casual factors is difficult to maintain for any government department. Hence most of the utilities were assuming a uniform figure for the entire state for the number hours a pump set works in a year based on the field assessment. Utilities adopted this procedure, as it is simple, despite the fact that working hours vary widely from well to well. Total agricultural energy consumption is estimated as a product of the number of agricultural services, average horsepower per pump set, and the number of working hours.

The above method of computing agricultural consumption is inaccurate and is not accepted by regulatory authorities or the government. Therefore, the pump sets have to be stratified into a set of classes based on the parameters influencing the energy consumption and follow the procedure outlined above.

Customer Classification

In addition to the general classification of customers by the utility base on their tariff category, the customers are further classified into different strata. Within each category the consumers can be divided into different strata. The set of factors used to characterize each stratum and distinguish one from another will differ from category to category. For example, the size of a

house, the number of people living in a house, and the economic status of the residents will be the factors used for the residential category. For the commercial category, the nature of business, the turnover, the transaction timings of the enterprise will determine the consumption level.. The utility will determine these factors for each category, and will further classify consumers into different strata.

Estimation of Total Losses

The technical Losses of distribution feeders are estimated by performing a load flow analysis. The accuracy of estimation depends upon the modeling of the network. The important issues of modeling are: load allocation, load modeling, energy loss estimation, and network configuration.

Load Allocation

For performing the load flow analysis, the simultaneous peak demand at each bus is necessary. Unfortunately, monitoring or recording either peak demand or simultaneous demand at each bus is not practically feasible. The only data available readily is the load data of the feeder at the substation. This demand is allocated among all the downstream buses considering the customers identified as incident at the bus as per customer indexing. Two allocation methods are generally adopted. One is based on the aggregate energy sales of all customers incident on the bus. The other allocation is based on the load curve of the bus evaluated considering typical load curves of different customer classes as per load research data.

Load Modeling

The influence of voltage variation on load characteristics is significant, and it is desirable to consider it for accurate load flow analysis. The loads can be broadly classified into three categories, viz., constant current, constant impedance and constant power, based on the influence of voltage variations on loads. The load voltage characteristic of the above three types of loads are shown in Figure 5-6 and is represented by an equation, as follows;

$$\frac{P}{P_n} = \left(\frac{V}{V_n}\right)^k$$

where

P = Power at voltage V

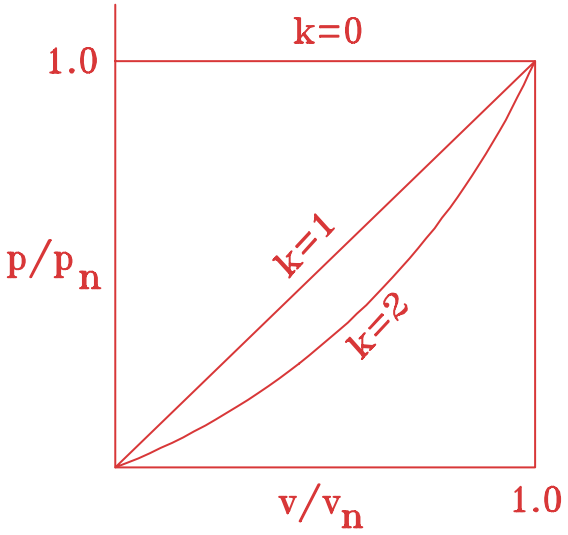
V = Voltage at the bus

Vn = nominal rated voltage

Pn = nominal active or reactive power of load

K = an exponent describing the voltage sensitivity of the load

Figure 5-6 – Voltage Characteristics of the Three Types of Loads



For constant power loads K=0; for constant current loads K=1; and for constant impedance loads K=2. In a graph of P/Pn against V/Vn, K is the slope of the curve at the operational condition. Most of the loads in the practical distribution networks are the composite loads that are assumed to be a combination of constant current, constant impedance and constant power. The load voltage characteristics of practical loads are represented by an equation as shown below.

$$P=P_n(K_p + K_c \times V^1 + K_i \times V^2)$$

where Kp, Kc, Ki indicate proportion of constant power, constant current and constant impedance component of load and (Kp + Kc + Ki = 1.0)

Energy Losses
The load flow studies give the peak power loss on the feeder. The energy loss is computed using any one of the methods described below.

Method 1: Empirical loss factor Method: Loss factor is defined as a ratio of power loss in kW occurred during its designated period to the peak or maximum loss occurred in that period. The following empirical formulae are used for computing the loss factor (ELF) in terms of load factor.

$$ELF = A*LF + (1-A)*LF^2$$

where the value of A is found to vary between 0.15 to 0.3

Method 2: Analytical loss factor method: In this case, the loss factor is evaluated from the load data. The expression for loss factor when 8760 hourly readings are available is given by

$$ELF = \frac{1}{8760} \sum_{i=1}^{8760} Li^2 \; / \; L^2_{Max}$$

where Li is the load at the 'ith hour, L_{Max} is the Maximum Load incident on the feeder

Since it is difficult to obtain 8760 hourly readings for each feeder, the loss factor is evaluated by gathering 24 hour load readings for a typical working day & holiday in each month and for 12 months in a year, and also by assigning due weight to the readings obtained. The loss factor in this case is given by

$$ELF = \frac{1}{8760}\left[\sum_{i=1}^{12}\sum_{D=1}^{2}\sum_{J=1}^{24} L^2_{i,D,J} W_{i,D}\right] / L^2_{Max}$$

where,

$L_{i,D,J}$ = Load in 'i'th month 'D' day and 'J' th hour

$W_{i,D}$ = Weight for 'i'th month and 'D' day and is equal to the number of working days/holidays in a month.

If D = 1 it is a working day, and if D = 2, it is a holiday.

Method 3: Annual Load Duration Curve Method: The load duration curve shows the frequency of distribution of load, i.e., the number of occurrences of load level within a range specified during the year. The demand loss at each load level is computed by performing load flow analysis, considering the load on the feeder to be equal to the peak load multiplied by mid point of the range. The energy losses are computed as the sum of the products of demand loss and frequency of level i.e., number of hours for all the load levels.

Method 4: Typical daily load curve: In this case the daily load curve feeder is taken and load flow analysis is performed for the load at every time interval. In other words, 24 load flows are performed if the daily load curve is built on hourly load readings, and 48 load flows are performed if the load curve is built on half-hourly load readings. Since the load curve varies from day to day, a typical load curve is built from the daily load curves of designated periods as described below.

- The daily load curve of each day is normalized such that the maximum day load is represented by 1.0, and the load at other hours is a decimal fraction of peak load.
- Hourly load of the typical daily load curve is computed as the hourly load average for that particular hour for different days throughout the designated period.
- Peak load of the typical daily load curve is computed as the average of the peak loads reached for different days during the designated period.
- The energy loss is computed as the sum of products of load loss at different time intervals and the duration of the time interval.

Method 1 is most commonly used for estimation of energy losses and is accurate enough for all planning studies. Methods 3 and 4 are more accurate compared to Methods 1 and 2. Methods 3 and 4 require daily load curve data from the facility. Method 3 has an advantage of integration with Method 4 of load allocation based on customer class load curves to give best accurate method for estimation of losses. In sum, Method 4 can be considered as the best among the four methods described above.

Network Configuration
The traditional methodology of load flow analysis is to conduct the study feeder wise assuming that each feeder is an independent network and the voltage at the source substation for the feeder is the rated voltage. The disadvantages of this method are:

- It does not reflect the actual operating conditions of the system, as the voltage at the start of each feeder may not be the rated voltage.
- The effect of power/ distribution transformers tap positions, capacitors, and voltage regulators are not properly reflected.
- Only individual feeder peak demands are considered, while coincident demand of the system is not.

Therefore it is necessary to perform load flow analysis of the integrated multi voltage network. It is suggested that the entire distribution network downstream of EHV substation with its associated distribution substations and the network be constituted as a tree and load flow analysis performed. The advantages of this method are that it:

- Takes into account the actual recorded voltage at the EHV substation bus
- Considers the effect of tap position of transformers / regulators and capacitors
- Takes into account the coincident demand of the network tree

Case Study

The energy balance performed for Vadodara City Distribution System in the State of Gujarat, India is described in this section. The pamphlet issued by the Gujarat Electricity Board on the occasion of the inauguration of the project, by the honorable Chief Minister of Gujarat, is also attached.

Features of the Project Area
Vadodara city is one of the important commercial capitals of Gujarat State, with historic importance as a city of rich heritage and culture. The city is situated on the west coast of India and is 392 km from the city of Mumbai. Vadodara has a population of 1.7 million and is spread over 300 sq. km.

Distribution System Profile
The city is fed from Gujarat Power System via two 220kV substations, one 132kV substation and fifteen 66kV substations. The length of the 66kV line is 84 km. The primary distribution voltage is 11kV, and secondary distribution voltage is 415V / 240V. The distribution system is predominantly overhead construction. The length of 11kV line is 725 km on 19,820 poles, and the number of 11kV feeders is 136. The number of distribution transformers 11kV / 415 V is 3,036 with a total capacity of 426.3 MVA. The rating of the transformers ranges from 1,000kVA to 25kVA. The total length of LV line is 1,624 km, the number of LV feeders is 4,451, and the number of LV poles is 57,615. The network has a total of 432,000 customers, and of these 198 avail of supply at 11kV and above, with the remaining customers at 415V. The total energy sales are 757.1 GWh units per annum, and the total revenue is Rs.3,360 million (US$ 74.5 million) per annum.

Building GIS
A GPS network survey commenced in July 2002 and was completed in November 2002. The latitudinal and longitudinal position of every pole, distribution transformer and all other electrical equipment was identified using handheld GPS signal receivers. A GPS base station was installed at Vadodara, and the readings of the rovers were processed for differential correction to get one-meter accuracy. The single line diagrams of all the substations and distribution transformer stations were obtained and digitized to ensure true ground representation. The technical particulars and other data of the assets on the lines and substations were collected and inserted into a database.

Customer Indexing
All 432,000 customer premises were visited, the pole on which they were incident was identified, and all customers were indexed. A map of the network showing substations and 11kV network is shown in Figure 5-1.

Energy Balance and Accounting
The present project involves implementation of all the types of balance defined earlier, including the most difficult to implement, the customer balance. Implementation of these balances has proved the fact that if systematically approached and executed correctly, all these balances are practicable and can be performed by utilities. Further to building the GIS system, the other requirements of balance, namely metering point identification and meter installation, customer classification, energy sales estimation, and estimation of technical losses through load flow analysis were complied for all types of balance on the Vadodara city power system. The subsequent sections explain how the utility conducted the different types of balances, and show the results.

Software Tools Used
POWER AUDIT, a software workstation developed by Global Energy Consulting Engineers is used for performing energy balances. The module is capable of performing feeder energy balance and transformer energy balance showing total losses, technical losses, commercial losses and ATC losses. ATC losses are defined as the difference between the energy input and the energy for which bill amounts could be realized by the utility. This gives a true performance index of the utility's financial status. The application is integrated with the customer billing database, and it will serve the meter readings of each customer relevant to the energy balance period, and computes pro rata energy sales of the customer for the energy balance period. This facility and computation is necessary as the customer meter readings are spread over 15 to 30 days in a month, and the energy balance period and therefore meter reading period would not exactly tally with the energy balance period. Similarly, the energy consumption pattern of same-class customers is computed on the basis of specific energy consumption i.e., kWh per kW, and the utility can identify customers to monitor due to abnormal variation in consumption patterns. This will greatly help prevent energy pilferage by unscrupulous consumers.

City Balance
The city distribution receives power supply from GEB grid at 3 points, namely 220kV substation at Jambuva, 220 kV substation, at Wagodia, and 132 kV substation at Gotri. The total energy received in the month of April 2002 is 68.2 GWh. The city distribution organization structure comprises of 1 circle office, 3 divisions and 15 subdivisions. The energy sales for each month by sub-division is readily available, as the customer database and customer billing are performed by sub-division. The total energy sales for the city distribution in the month of April 2002 is 5.92 GWh. The total energy losses are 2.06 GWh, or 34.79%. Based on a load flow

analysis, the utility estimates technical losses of 0.36 GWh, constituting 5.71% of energy input. Therefore, the commercial losses are 1.7 GWh, or 20.08% for the month of April 2002.

Feeder Balance
There are 136-11kV feeders in Vadodara City. Electronic tri-vector meters with load survey capability are installed on all the feeders. These meters record kWh, amps and Volts every fifteen minutes. Similar meters were also installed on 111 distribution transformers incident on Motibagh substation.

The energy balance was performed using application software called POWERAUDIT™ developed by Global Energy Consulting Engineers, Hyderabad. The software identifies the customers who are incident on the feeder based on customer indexing. The software performs topology analysis and identifies the poles belonging to each feeder as per the network configuration prevalent in that period. If there are any changes in the configuration during the energy balance period, this is also taken into consideration. The energy consumption for each customer is computed on pro data basis considering the billing cycle. The energy sales of all customers are aggregated to arrive at the energy sales of the feeder.

In Vadodara, the utility reads 11,015 customer meters and bills each monthly, and for the remaining 420,985 customers, the utility does the same on a bi-monthly basis. The energy balance was performed for a one month duration and outputs included the number of customers on the feeder and the number of customers for whom readings are taken into account for energy balance. The list of customer names were also printed to facilitate validation. The management was also able to view the customer list for each transformer, as well as details of their energy sales computation. The software application generates the following reports by default or by user request.

Customer Balance
The pattern of energy consumption of the hotels in Vadodara city is compiled. The energy sales, contracted demand and specific energy consumption for kWh per kVA for two medium-sized three-star hotels was compared. Reviewing the data, it was seen that the consumption pattern of some hotels were consistently much lower compared to the consumption pattern of others. The utility staff was asked to investigate the reasons for low consumption, and the investigations revealed that the candidate hotel was not using electricity for air conditioning, and using other energy sources such as gas for that purpose.

Table 5-2 – Comparative Statement on Energy Consumption of Two Hotels

Month	Hotel A		Specific Energy Consumption	Hotel B		Specific Energy Consumption
	CMD	Energy		CMD	Energy	
Dec-02	325	106852	328.78	140	30521	218.01
Nov-02	325	119140	366.58	140	36879	263.42
Oct-02	325	122004	375.40	140	36287	259.19
Sep-02	325	145724	448.38	140	39211	280.08
Aug-02	325	12680	39.02	140	31550	225.36
Jul-02	325	128144	394.29	140	35899	256.42
Jun-02	325	142064	437.12	140	37878	270.56
May-02	325	134908	415.10	140	35714	255.10
Apr-02	325	114804	353.24	140	24314	173.67

VI. Electricity Metering

Metering, in the context of power distribution companies and power sector reform, is an essential component of building commercial operations and promoting a robust and efficient energy sector. In the most basic sense, metering is essential to account for power inflows and outflows within a distribution network. Accurate accounting electricity sales, the utility's commodity, is the most fundamental element of sustainable operations.
The purpose of this chapter is to introduce metering concepts and programs, and to highlight the key factors for successful implementation of metering programs. This chapter is devoted to the following topics:

- The Importance of Metering
- Metering Strategies
- Commercial Implications
- Metering Programs
- Program Implementation
- Equipment Selection
- Case Study
- Lessons Learned

Importance of metering

Accountability is the fundamental basis for any metering program. It is a generally accepted principal that a commercially successful utility will meter, to the greatest extent possible, all electricity purchased and sold. Accurate and all encompassing metering is the only way to ensure accountability for purchases, sales, and losses. In addition, accurate metering will enable the utility to effectively balance its loads, load shed when necessary, and implement a cost-based system of dispatch and purchases for optimal technical system efficiency.

However, metering is analogous to any other infrastructure program where the utility must weigh costs, benefits, and expected results in order to achieve the optimal return on investment. Not all metering applications can be justified for all utilities. An effective metering program is also much broader than the meter device itself. An effective metering program requires data acquisition, data processing, compatibility with billing and collections systems, and maintenance. It is equally important to ensure that meters are tamper proof. A metering program is only successful insofar as the data serves to improve billing and collection, network operations, and ratemaking.

Previously, state-owned vertically integrated utilities in many developing countries felt only a minimal need for metering. Since the costs of generation, transmission, and distribution were integrated, only primary fuels and end-user consumption were metered. And even under this scenario, heavy government subsidies often made the collection of metered values a moot exercise. The current trend in unbundling, commercialization, and privatization, and elimination of state subsidies, has created an urgent and immediate need for accurate and encompassing metering throughout the power sector in many countries. As a new concept for many utilities,

many struggle with the technical and investment requirements to achieve effective metering. Yet, without it, no utility can hope to establish a commercial base of operations.

Lastly, the institutional and regulatory environment is dependent upon, and must support, a metering program. The determination of cost-of-service based tariffs, identification of subsidies, and the establishment of performance standards all depend on accurate network metering information.

Metering Strategies

All utilities must establish an effective metering strategy. Metering strategies will vary depending on the relative stage of development of a utility, and the general maturity of the power sector. Experience has shown that most utilities undergo transitions starting from a developing phase, through an intermediate phase, and ultimately to a mature phase. Each of these phases have unique requirements, constraints, and expected results (see Table 6-1).

Table 6-1 – Metering Strategies by Utility Development Phase

Type/Phase	Developing Phase	Intermediate Phase	Mature Phase
Description	This phase is characterized by low collections, high losses, inadequate metering, and lack of capital and utility management expertise	Substantial revenue metering has been implemented and the utility is becoming commercially viable and able to concentrate on operational improvements	Well functioning utility with high collections, low losses, efficient network operations and seeking the highest level of efficient operations and customer service
Requirements for Improvement	New and/or upgraded metering for maximum accountability of inflows and outflows	Upgraded metering and associated systems for collection of network operating characteristics for monitoring and control	Upgraded metering and associated systems for collection of additional network operating characteristics to implement advanced methodologies
Constraints	Lack of capital and expertise for 100% metering	Capital and expertise for upgraded metering and SCADA systems	Capital for upgraded meters, expertise for advanced tariff methodologies, and regulatory incentives.
Expected Results to Progress to Next Phase	100% metered energy to consumers	Improved network performance and control	Incentive tariff mechanisms adopted for increased utility efficiency and lowest power rates with standards of service

In the context of developing countries, and this report, the remainder of this chapter will concentrate on the developing phase. However, it is important to keep in mind that, for a utility to advance to the intermediate and advanced phases, upgraded meters and associated systems will be required. It is possible for a utility to pre-invest in these advanced meters for this capability, at least for major suppliers and consumers, but it requires adequate funding and technical specification expertise.

Identifying a metering strategy can be characterized by establishing three fundamental types of metering associated with the corresponding development phases of the utility. The types of metering are the following:

- *Revenue* – Basic revenue metering, which accounts for kWh consumption, may be electronic or mechanical, read manually or automatically, and may have data storage and analysis capability. Such meters range in price from approximately $50 to $250, depending on the country of manufacture, accuracy rating, and functional meter capabilities.
- *Network* – Advanced metering that not only measures kWh consumption, but also system characteristics such as: voltage, current, reverse and reactive power; and may compute such operating characteristics as: power factor, time-of-use, trends, peak and valley loads, etc. Network metering usually has significant data storage and analysis capability and will interface electronically with advanced automated data acquisition systems. Meters in this range may cost from $250 to $1,000 or more, depending on the capabilities.
- *Ratemaking* – Additional enhancements to network meters that allow for the collection and analysis of system characteristics to support advanced ratemaking methodologies. Meters are always integrated with a SCADA and possibly DCS control systems. Metering enhancements for ratemaking may cost in the $250 to $500 range over and above the network meter cost.

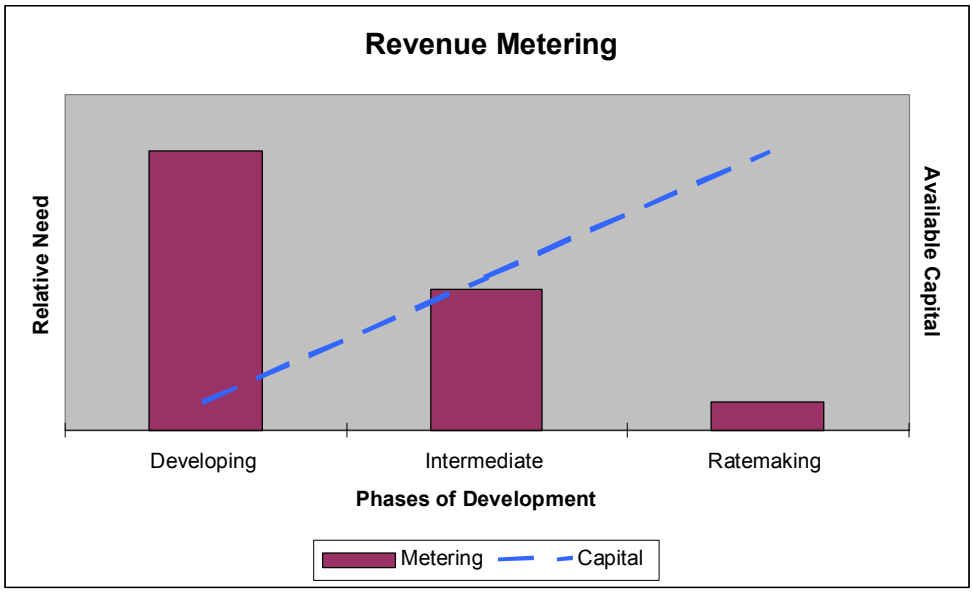
The need for specific metering by phase of utility development is illustrated in Table 6-2 below:

Table 6-2 – Need for Metering by Development Phase

Type/Phase	Developing Phase	Intermediate Phase	Mature Phase
Revenue	High – The immediate need is for accurate and comprehensive metering to raise collections and reduce losses	Medium – Substantial revenue metering in place	Low – High level of revenue metering essentially accomplished
Network	Low – Capital not available yet. Increasing revenues are the main priority.	High – Network operations become a priority as revenue metering is substantially accomplished and capital is available for improved network operations	Medium – Substantial network metering in-place.
Ratemaking	Low – Advance ratemaking only a future possibility	Medium – Advance ratemaking being considered	High – Advanced ratemaking offers possibilities for improved commercial operations

Figure 6-1 illustrates the relative need for revenue metering vs. available capital. This inverse relationship is one of the biggest challenges facing developing country distribution companies seeking to achieve commercial operations.

Figure 6-1 – Revenue Metering Need vs. Available Capital



After establishing this framework for metering type and associated development phases of a utility, we can lay out a basic strategy for the development phase of metering to improve distribution company operations and accelerate power sector reform, which would be to:

- Implement 100% revenue metering at supply and sales nodes throughout the distribution system.
- Implement a data collection system so that the utility's billing and collection systems can effectively utilize this information.
- Establish effective systems for meter security, calibration and maintenance to ensure the reliability and accuracy of the information collected.
- Implement advance metering for network system control, optimization, and to support advanced ratemaking methodologies as required.

As a final clarification, the concept of 100% metering does not necessarily mean that each and every customer will have a physical meter. For low consumption customers (urban and rural), a physical meter may not be cost effective. In these cases, a group of customers may be collectively metered and an alternate methodology adopted for allocation of usage to each customer. However, at some designated node in the distribution network, the utility must meter and account for consumption (aggregate or individual).

No strategy would be complete without addressing the social needs of the country. Many societies that are transitioning to a market based economy need to assure the general population that their basic needs for electricity will be met at an affordable rate. Customers, which have previously received subsidies, free electricity, and/or acquired electricity by bypassing meters, are nervous about accurate metering and may resist. The government and utility companies need to proactively communicate the need for accurate metering, a fair and reasonable disconnection policy for non-performing customers, and lifeline tariffs and/or subsidies for the needy. The utility will need to educate and assure customers that a

commercially sound utility will benefit all customers in the long run, and accurate metering is the basis for commercial operations.

Commercial Implications

The commercial implications of distribution company metering programs are profound. As stated previously, metering is the fundamental basis for power purchases and sales accountability. Without effective and accurate metering, no distribution company can expect to become commercially viable.

The implications can be summarized as:

- *Power Purchases (Supply Metering)* – Accurate accounting of power purchases will ensure that the utility pays only for power actually purchased, and that price adjustments can be optimized for the purchase conditions. Accurate supply metering will give the utility the information it needs for: supply/sales accounting, load balancing and supply forecasting, negotiation advantageous supply contracts, and accurate determination of any penalties associated with supply conditions. Supply metering represents the single largest metering application by network node, and is critical to a utility's operations. The cost/benefit of installing and maintaining accurate supply metering is nearly always justified. It should be noted that in the case of a disco, this metering is primarily for verification purposes. The Transco or ISO metering is generally used to determine the amount of power purchased. Even so, it may be a good idea for the disco to monitor the flows.
- *Power Sales (Distribution Metering)* – Accurate accounting of power sales, in aggregate, is just as important as power purchases. However, given the wide coverage of most distribution utilities, meter installation at each and every sales node is a challenge requiring significant investment resources, technical capability, and expertise with data acquisition and utilization. The utility must apply sound and accurate cost/benefit analyses to each metering application, and seek innovative methods to achieve full accountability for those applications where individual end-use metering is not cost justified.
- *Data Acquisition and Utilization* – Complementing the actual metering of power purchases and sales is the ability of the utility to effectively utilize this information to generate revenue and reduce costs. This requires a program of sophisticated data acquisition and utilization (billing and collection, tariffs, loss reduction, etc.) be applied and implemented to optimize commercial operations.

A sound metering program will also boost the utility's credibility and creditworthiness, thus enhancing its ability to obtain financing, attract talented staff, negotiate advantageous supply and service contracts, and achieve high levels of customer satisfaction, all of which form the basis of sound and sustainable commercial operations.

Metering programs

Metering programs are diverse, and generally unique to the needs of a particular utility. However, some general components are universal. An effective and achievable metering program includes the following elements:

- *Supply/Demand Profile* – Develop a supply/demand profile to provide the utility with a sound characterization of how much power is being supplied from where, and to which customers. This enables the utility to begin metering improvement at the locations that will provide the

highest yield, and to perform cost/benefit analyses for alternate metering types metering at different locations.

- *Loss Reduction Survey* – As a complement to the supply/demand profile, identify high loss areas to enable the utility to direct metering improvement programs to these high yield areas as well.
- *Meter Characterization Survey* – The utility will need an accurate and comprehensive characterization of meters (type, condition, capabilities, etc.) installed in various locations. Modern techniques, such as GIS mapping, make this task easier, more accurate, and comprehensive. Before doing the survey, many utilities develop a service area wide system of metering tagging (labeling) and database characterization so that the survey needs to only be done once. This approach not only establishes the characterization, but puts in place a firm database of tracking and monitoring meter installations.
- *Metering Improvement Program* - Once the three preceding tasks have been accomplished, the utility can develop a metering improvement program that targets high yield metering applications first, estimates the cost/benefits, identifies funding options, ensures technical compatibility, implements a procurement and acquisition program, supports and identifies the need for any tariff adjustments, identifies data acquisition and utilization needs, and considers the social and ancillary implications.
- *Data Acquisition and Utilization Systems* – Complement the metering applications by acquiring and implementing efficient billing, collection, and accounting systems, and assuring system monitoring and information security.
- *Calibration and Maintenance* – Establish a calibration and maintenance program to ensure the meters function accurately and reliably.
- *Monitoring* – Implement a monitoring program which assesses the effectiveness of metering improvement on power purchases and sales, collections, loss reduction, and general improvement in commercial operations.
- *Public Outreach* – Conduct public outreach campaigns to inform and ‘sell’ customers on the needs and benefits of metering improvement.
- *Institutional* – The utility may lobbying for government support, promote laws and regulations which facilitate commercially-based operations, and ancillary program such as tax incentives, import duty exemptions on equipment, and concessionary financing if available.
- *Ownership* – Meter ownership is often a contentious issue when a utility makes the transition to full customer metering. In many developing countries, the customer owns the meter at the end-user point, while the supplier may or may not own the meter at the supply point. Conventional ownership follows the following guidelines:
  - Customer Meter (end-user) – The utility must own this meter to ensure accurate calibration and security. In some cases, the regulatory entity may require independent meter verification.
  - Supplier Meter – The supplier (Generator or TRANSCo) will always own the supply meter (commonly called the sales meter or custody transfer meter). However, many utilities also install a meter at the sales point for verification purposes. Advanced utilities will have an established meter proving protocol, and settlement mechanism for meter discrepancies, as a part of the power purchase agreement.
- *Preventing Theft and Tampering* – Most utilities have an established program of monitoring for meter theft and tampering. This may involve some, or all of the following, elements:

- Physical inspection of meter installations, seals, and distribution wiring for any tampering or illegal connections.
- Monitoring of consumption patterns from billing statements for abnormal activity.
- Load monitoring for abnormal load conditions which would indicate tampering.

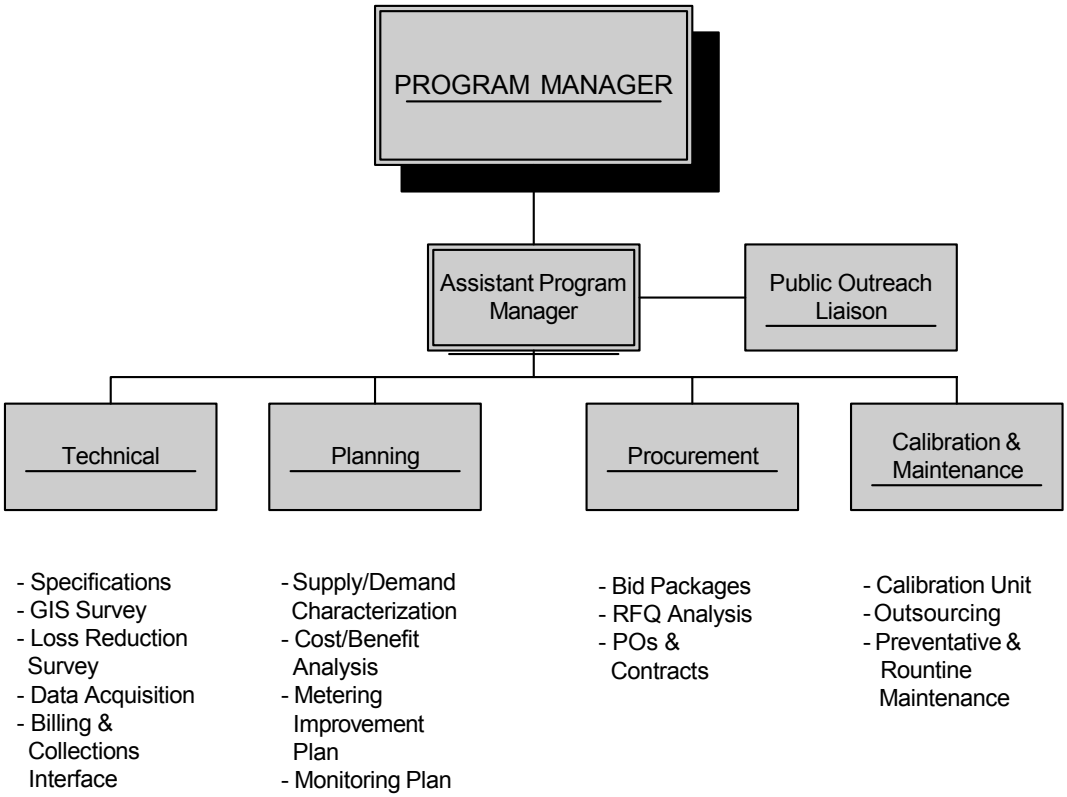
Of course the prevention program will only be successful if adequate laws are in place to prosecute violators and if the regulatory environment supports associated stiff fines and penalties.

All of these various elements are complementary and form the basis for an effective metering program that will support the utility's commercial operations.

Organizational Issues

A utility seeking to implement a comprehensive metering program will face many organizational challenges, both internal and external. Most important will be the need to bring many organizational elements into harmony so that the program results stand a high likelihood of success. One approach is to assemble a project task force that would draw upon many organizational units for staff and act as a central-point-of-contact for information and coordination. A representative metering implementation unit is illustrated as follows (Figure 6-2):

Figure 6-2 – Metering Improvement Program Organizational Unit



The unit could be located within an existing metering department in the utility, or created as a separate project implementation unit, depending on utility management's discretion. Each of the functional areas could be staffed by persons loaned from other utility organizational units, by contractors, or by supplemental staff hired for the program. At the conclusion of the program the unit staff would be relocated to other utility departments.

Implementation
A successful metering program will require diligent program implementation within the boundaries of the utility's responsibility and authority; as well as coordination with customers, external organizations, and suppliers.

Some of the common implementation considerations are:

- Developing detailed schedules (design, procurement, installation, commissioning, and testing/calibration)
- Establishing a predictable procurement pipeline
- Adequate warehousing, testing/calibration, and disbursement
- Procurement and stocking of spare parts, tools, and any special equipment needed to maintain the meters
- Training maintenance staff
- Adequate installation labor force
- Pre-installation preparatory work
- Installation plan that will minimize the impact to customers, while making maximum use of labor and materials
- Installation of follow-up quality control and code compliance
- Commissioning
- Testing interface with data acquisition system
- Testing interface with SCADA systems
- Post-installation documentation and reporting
- Establishing a preventative and/or predictive maintenance program
- Post installation project review of budgets, schedules, procurement and installation and other factors

All of these activities should be accomplished at regular phases during the life of the metering program, and subsequent phases improved as lessons are learned.

Post-Implementation Activities
Post-implementation activities are a critical phase of any metering program. Installation and commissioning is not sufficient to ensure the benefits of a metering program are sustainable and maintainable. In fact, considering the length of time to complete a comprehensive metering program, it may be years from start to finish; thus meters installed years earlier will have to perform up to the same standards as meters installed today.

Some of the more critical post-implementation activities include:

- Establish a preventative maintenance and predictive maintenance program
- Stock spare parts for the new meters
- Establish a testing and calibration program
- Establish a loss reduction program consisting of: billing analysis, load flow analysis, and random physical inspections
- Follow-up contacts with vendor(s) for ongoing support, upgrades, and procurement of new meters

In addition, the utility will need to update records and documentation as upgrades occur in the metering system, with corresponding updates to linkages with the main tracking system.

Equipment Selection and Procurement

Appropriate equipment selection will have a significant effect on the cost/benefit of any metering program. There is a wide variation in costs for utility metering, and this variation mostly depends upon the capabilities and accessories associated with meter selection. The utility must be diligent in assuring it procures meters that:

- Have sufficient design features to meet the metering requirements, but do not have unnecessary features that increase cost with little benefit
- Meet all normal industry technical and performance standards
- Are of quality and lasting construction
- Can be secured to prevent tampering
- Are easily serviceable (calibrated and maintained) both on a routine and emergency basis, and are supported by a reputable manufacturer
- Are easily interfaced and compatible with data acquisition and meter reading systems
- Can be upgraded later at reasonable cost if the need arises

Each of these considerations carries associated costs and benefits, and the utility should attempt to quantify each as accurately as possible. Ultimately, the utility would formulate these considerations into a criteria, specification, and procurement process that will enable the utility to make the best investment decision.

Design Features
A wealth of technical information exists on the various utility meter features and technical capabilities, and it is beyond the scope of this report to present an in-depth analysis. However, some of the principal design features that a developing country utility would look for are summarized in Table 6-3. Note that the optional design features usually incur additional costs and would, therefore, require justification. The list presented is only intended to be representative; the slate of possible design features is almost limitless and individual manufacturers offer a wide range of alternatives. These basic design features would normally be considered by the utility and form the basis for a design criteria and specification.

Table 6-3 – Design Features

Metering Requirement	Basic Design Features	Optional Design Features
Standards	Compliance with ANSI C12 electricity metering	Compliance with additional standards for particular applications
Physical Design	Socket mounted	Panel mounted
Security	Car seal	External secure (locking tamper-proof) enclosure
Energy Consumption (kWh)	Internal computation and visual readout (mechanical or digital)	Internal kWh data logging, trending, parameter logging, peak demand logging, power factor correction, etc.
Time-of-Use	Time-of-Use logging capability for energy consumption kWh	Additional internal storage for longer periods, trending, parameter logging, peak demand, etc.
Real-Time Tariffs	Time based kWh consumption that can be applied against time based tariffs	Internal computation, trending, additional internal storage, etc.
• Load Profiling	Collection of load monitoring parameters	Trending, averaging, internal computation, additional storage for extended periods
• Power Quality	Collection of power quality parameters	Harmonics, transients, outages, voltage disturbances, etc.
• Alarms	Alarm conditions	Remote alarm reporting, variable set points, logging, trending, etc.
• Remote Metering Reading	Metered parameters can be read remotely	Data communications links, web based communications, LAN, or WAN
• SCADA	Integrated with SCADA systems	Additional control features
• Data Storage	Limited to meter reading cycle	Expanded for data backup, analysis, etc.
• Calibration & Maintenance	Easily calibrated and maintained with existing utility equipment and staff; local vendor support available	Enhanced calibration and maintenance capability; regional vendor support available
• Compatibility	Compatible with other utility meters and data acquisition systems	System interfaces
• Security	Positive mechanical seal with provision for meter seal(s)	Additional external case with tamper-proof cable connectors and locking mechanism,

Appropriate Technology Choice

Selecting appropriate metering technology is one of the most important decisions facing a utility, primarily because of the cost impact. Modern meter design has ensured that even the most basic meter will have the accuracy necessary to effectively track power purchases and sales, thus this is usually not a major issue.

The factors over and above this basic requirement are:

- What additional features will provide a cost benefit to the utility, and can this be quantified in order to make a sound investment decision?
- Which manufacturer's technology will provide the best pricing for the required meter features?
- Will the manufacturer follow-up support, maintenance, and expandability of the basic meter be adequate and cost justified?
- Will the technology choice become outdated? If so, what will be the cost of upgrading and/or replacing it?
- Will the technology choice blend with existing equipment and ancillary data acquisition systems to enable a smooth integration into the utility's infrastructure, or will the utility have to make a major change and investment to accommodate the new technology?
- Are the utility organizations (engineering, operations, billing and collections, accounting, etc.) ready to receive the selected technology?

A utility can address all of these questions by establishing decision criteria, applying a logical decision making process, fully evaluating all the associated costs and benefits, and then committing the utility's resources to make the technology choice work.

Selection Criteria
Establishing sound selection criteria is essential for a utility to make the appropriate equipment selection, and must involve all organizations within the utility. In general, the criteria can be organized into the following major areas:

- *Technical* – Compliance with standards, design, features, reliability, expandability, utility data requirements, etc..
- *Calibration & Maintenance* – Frequency, manufacturer support, in-house capability, outsourcing.
- *Compatibility* – Compatible with existing metering and associated systems.
- *Contractual Terms* – Equipment cost, payment terms, warranty, subsequent procurement.
- *Data Acquisition* – Compatible with existing systems or requirements for new systems.

Procurement
Once the utility has established the design specifications and selection criteria, it is ready to begin the procurement process. The following considerations need to be taken into account:

- *Source Origin* – Will the tender offer be open to all firms worldwide? Sometimes utilities face pressure (particularly state owned utilities) to buy nationally. There are also good reasons for sourcing equipment 'close to home': availability of local support, understanding of the local environment, long-term commitment to a business relationship, and consideration of feedback from their utility concerning their unique requirements. On the other hand, offshore suppliers may offer a lower initial price to become established in the locale of the utility.
- *Bundled Procurement* – Most vendors make a considerable profit on follow-up equipment sales support through maintenance, spare parts, installation, and upgrades. They will often discount the metering equipment in order to capture the ancillary services and support. The utility might consider a bundled procurement which would not only cover the meters themselves, but all the ancillary services as well.

- *Bid Analysis and Selection Committee* – In order to ensure a transparent process, the tender offering should be as open and transparent as possible, with a structured evaluation and selection process.
- *Contract Award* – Once the utility has made a decision, it should aggressively negotiate with vendors in order to extract the best pricing, terms, and delivery. Suitable remedies for non-performance should be built into the contract and all legal implications should be evaluated carefully.
- *Delivery, Warehousing, and Disbursement* – Once the meters begin arriving, the utility will need to arrange for delivery location, an adequate warehousing area (storage), inspection, acceptance, and a disbursements procedure to field installers.

Once the meters are handed over to the installers, the procurement process is essentially complete. Follow-up documentation will need to be completed, as will certificates of inspection, warranty registration, and meter location data records.

Case Study

Every utility has different requirements and no one metering program will fit all. However, case studies provide valuable lessons of applied metering programs, benefits, drawbacks, what worked well and what did not.

The following case study covers a metering improvement project that was implemented Armenia from 1996 to 1998.

ARMENIA METERING IMPROVEMENT PROGRAM

When Armenia unbundled its vertically integrated power sector into functional entities, it created four state-owned distribution companies. The Government intended to privatize these companies, but first recognized the need to improve their financial and operational performance. One major area in need of improvement was metering. Under the vertically integrated company there was no need for accurate metering of power purchases and sales, and the electricity was priced at levels based on social need, so even end-use metering was not important. However, when transformed into a corporate entity responsible for financial sustainability without state subsidies, the accurate measurement of power bought and sold became paramount.

The Government of Armenia sought donor support to procure a large quantity of revenue meters. While there was interest among the donor community, it was recognized that simply procuring metering hardware was not enough: the Utility needed program management support and ancillary systems to support the meters. The United States Agency for International Development (USAID) developed a comprehensive metering improvement program designed to assist Armenia to obtain the maximum benefits from such a metering program.

The resulting metering improvement program accomplished the following tasks:

- Approximately 10,000 revenue meters for industrial, commercial, and residential applications
- Calibration and testing equipment
- CTs, cabling, and interconnection equipment
- Security enclosures for meters
- Substation accounting meters
- Installation test equipment
- Billing and collection hardware and software
- Data acquisition hardware and software
- Training and vendor technical support
- Project management and procurement services
- Pilot demand side installation program,
- Pilot apartments building renovation program
- Technical assistance to design associated tariff mechanisms
- Support for utility-sponsored public information campaigns

Following implementation of the complete metering program, the utilities experienced a significant reduction in losses, increased collections, and significantly improved utility operations and financial performance. For example; in the renovated apartment buildings the incidence of theft, meter tampering, and illegal connections dropped to zero. Collections dramatically increased, and the distribution utility began a disconnection procedure to ensure timely collections. The final testament to the metering program came when the Government successfully privatized one of the utility companies, selling to a private investor owner-operator. However, the program was not without setbacks, as strong resistance from many customers had to be overcome.

Lessons Learned

The lessons learned from implementing metering improvement programs around the world, and particularly in developing countries, are fairly straightforward. The following key lessons are representative of most Distribution Company Improvement Programs with respect to metering:

- Metering hardware is not, by itself, enough to realize the benefits of the investment in metering. Ancillary programs for data acquisition, billing and collections, calibration and maintenance, security, tamper-proof connections, and customer information are critical to the success of the metering program.
- A dedicated metering program management and implementation unit within the utility is necessary to ensure adequate program management and financial control.
- An open and transparent procurement program will add credibility to the utility's metering program.

- Open and constant communication within the utility (i.e. other organizational units such as finance, billing, maintenance, etc.), is necessary to ensure a holistic approach and that adequate interfaces are established.
- Public outreach and communication are an important element in any metering program.
- External communications with government bodies, the regulator, and others will enhance the utility's ability to successfully implement the metering program.
- Adequate time and effort to develop a suitable equipment design, vendor selection criteria, and bid evaluation process will save the utility money and ensure a credible cost-benefit ration for the equipment purchased.
- Above all, the management of the utility must be 100% committed to the metering program.

VII. Billing Programs andSystems Architecture

Introduction to Customer Information Systems

Overall MIS for Distribution Companies
A Management Information System (MIS) for a standalone electricity distribution company should include all data necessary for corporate decision-making. In general, a good corporate management information system will include: accounting and financial recording and reporting systems; human resources management; management systems for materials (i.e., inventory), maintenance, project development, and working capital; customer information system (CIS), decision support systems, and possibly a customer relationship management (CRM) system. If restructuring has not yet occurred, and a distribution company is still part of a bundled electrical power system, the MIS components are still necessary, but may be an integral part of the overall corporate information system.

Although historically information subsystems were paper-based, distribution companies, particularly those in developed nations, have transitioned toward electronic MIS systems. Many companies throughout the world, however, still have MIS system components that rely on both electronic and paper media. Many developing country entities simply have not had the funds to progress from paper records or simple spreadsheet models. In addition, many electricity distribution companies in the former Soviet bloc countries are just starting to move toward privatized (or corporatized) market-based metering, billing and collection models that demand electronic information systems. Most progressive companies in market-based economies is now store data electronically. Given the diversity in the state of development and large variances in resources available in different countries, it is important to emphasize a single MIS solution will not fit all needs.

A distribution company may implement an MIS system either by purchasing and installing a tightly integrated Enterprise Resource Planning (ERP) suite, or by implementing and integrating “best-of-breed” applications.

Enterprise Resource Planning
An ERP suite integrates key management and business processes so that information from one function is automatically available to other functions. ERP systems typically incorporate as a minimum the following management control systems and processing functions: accounting (recording and reporting, accounts receivable and payable, and balance criteria), financial model and reporting (income statement, cash flow, balance sheet, financial forecasts), human resources information and payroll data. In addition, the ERP may also include manufacturing components such as procurement and inventory control, materials management, billing, plant and equipment maintenance, fleet management, project management systems, working capital management, and decision support systems.

The concept of an ERP is very appealing in that custom programming is minimized. However, ERP systems require a significant amount of effort, time and money to implement. Often times the business processes must be adjusted to conform to the ERP system methodology.

Best-of-Breed
An alternative approach is to select high quality application packages that address a single function. These "best-of-breed" applications must then be integrated, which requires a significant amount of custom programming. One advantage of this approach is that the company can adjust the overall system to their specific business processes.

Major MIS Components and Data Flow
The following schematic represents the major elements of a typical MIS system for an electrical utility company and the top-level data flows amongst the system components. Integrated ERP systems may or may not include all of the components as standard elements. Each utility will have a unique system specification that will define the necessary components for the overall MIS. A short description of the functionality of each major component follows.

- **Planning and Budgeting Module:** Planning and budgeting models are a critical element for any business entity. It is important that these modules are consistent (share the same chart of accounts or have a mapping algorithm) and that they are integrated with the accounting and financial modules.
- **Financial/Accounting Ledger Systems:** Again, these are essential components for utility. All of the major ERP systems and many individual accounting/financial management packages provide excellent product offerings. Many ERP type solutions have strong financial modules but lack the range of additional modules, such as billing or construction management. In non-US locations the standard for accounting practices is International Accounting Standard (IAS) principles.
- **Human Resources and Payroll Systems:** A modern, integrated system is required to manage employee data and payroll information. Payroll and HR procedures are unique for each country.
- **Procurement Management Systems:** Transmission, distribution and generation systems require maintenance and new capital construction projects. Financial control of large capital construction projects is necessary to allow management to quickly and continuously monitor the construction projects.
- **Materials and Inventory Management Systems:** Materials (inventory) management is a necessary component of an operating entity such as a distribution company. An integrated inventory system also allows the entity to control stocks and possibly avoid duplicating inventory.
- **Fleet Management System:** A distribution or transmission company that administers assets over large distances must track vehicle usage. Fleet management is a fairly generic process, but several large ERP systems do not contain such modules.
- **Decision Support System:** A decision support system (DSS) is required to provide corporate management with feedback of critical key performance indicators (KPI). A DSS may take several forms. A common approach is to develop a data warehouse from which KPI data can be drawn. Alternatives include models of the enterprise that management can use in a "what if" mode to evaluate the possible impacts of actions or scenarios. A data-driven system (i.e., data warehouse) must be integrated with the overall MIS, whereas a model-driven DSS may be loosely coupled (for example, key assumptions such as interest rate, cost of materials for all regions, should be common with the corporate MIS).
- **Customer Information System:** A customer information and billing system (CIS) fulfills the second most important function for a distribution company. After delivering electricity to its customers, a utility company must bill its customers efficiently. In addition, a CIS can be

used to distinguish between very profitable and less profitable customers through load usage data. A CIS may also contain some of the elements of a CRM system.

- **Customer Relationship Management System:** A CRM system is designed to provide information to allow the company to service customers more efficiently. A CRM will concentrate on service-oriented activities such as customer set-up, switching to or adding other services, settling accounts, fault correction, servicing requests for information. A CRM may or may not include billing and payment functions, although it will certainly be linked to a billing system.

Data Flow
Data flow in an MIS must be carefully designed and controlled. Each information system component has its own data model and is designed to be internally consistent. For instance, an accounting, or recording and reporting, system is based on a clearly defined chart of accounts, and ledger entries are controlled according to well-defined procedures. Accounting systems typically consist of modules with the following functionality: general ledger; fixed assets and register; accounts payable; payments and check writing; cash management; budgeting; and project account and activity based account (i.e., job costing). In turn, the accounting system must exchange data with other systems. A portal is one way of providing integration between the accounting system and other systems such as: customer information system; human resources management system; maintenance management system; and materials management system.

On the following page, Figure 7-1 illustrates data flow between the various systems indicated, although it does not show internal data flow within individual systems. Data flow between various system components may require “data cleansing” or “data scrubbing”. For instance, data coming from workstations or standalone data collection systems may to be verified and converted to different data formats. Data may also have to be aggregated. As an example, it would not be desirable to import all customer account information into an account receivable module in the accounting program. Instead, data may be aggregated by customer class in the CIS system, and only the class totals would be imported into an accounts payable ledger. Figure 7-2 shows data flow for a CIS system. This diagram reflects the workflow processes—it does not indicate the application’s storage structure. It also depicts the logical linkage to the accounting system.

Decision support systems may be used to investigate trends which require aggregate information from other modules. Rather than transfer all account information to the DSS from the accounting system, monthly summary data may be prepared and transferred. Then, using the decision support analysis tools, trends over a period of years may be captured.

Information System Market Leaders
The market leaders in the large enterprise ERP area are SAP AG, Oracle Corp., and Baan Co. NV. An alternative model now being heavily promoted and implemented is called the Enterprise Asset Management (EAM) model that is oriented toward asset-intensive industries such as utilities. Leaders in this category for the energy industry are Indus International (which recently purchased the Global Energy and Utility Solution division of SCT Corporation), MRO Software, Inc., PeopleSoft Inc. (which recently acquired J.D. Edwards & Co., and is now an acquisition target of Oracle), and Mincom. Many consider the ERP model to be most applicable to manufacturing industries, and EAM to utilities, although the distinction is questionable given the large investment in assets in many manufacturing sectors (e.g., automobile, aerospace, defense, etc.). It is probably more appropriate to say that some vendors such as SAP, Oracle

Figure 7-1 Management Information Systems and Data Flows

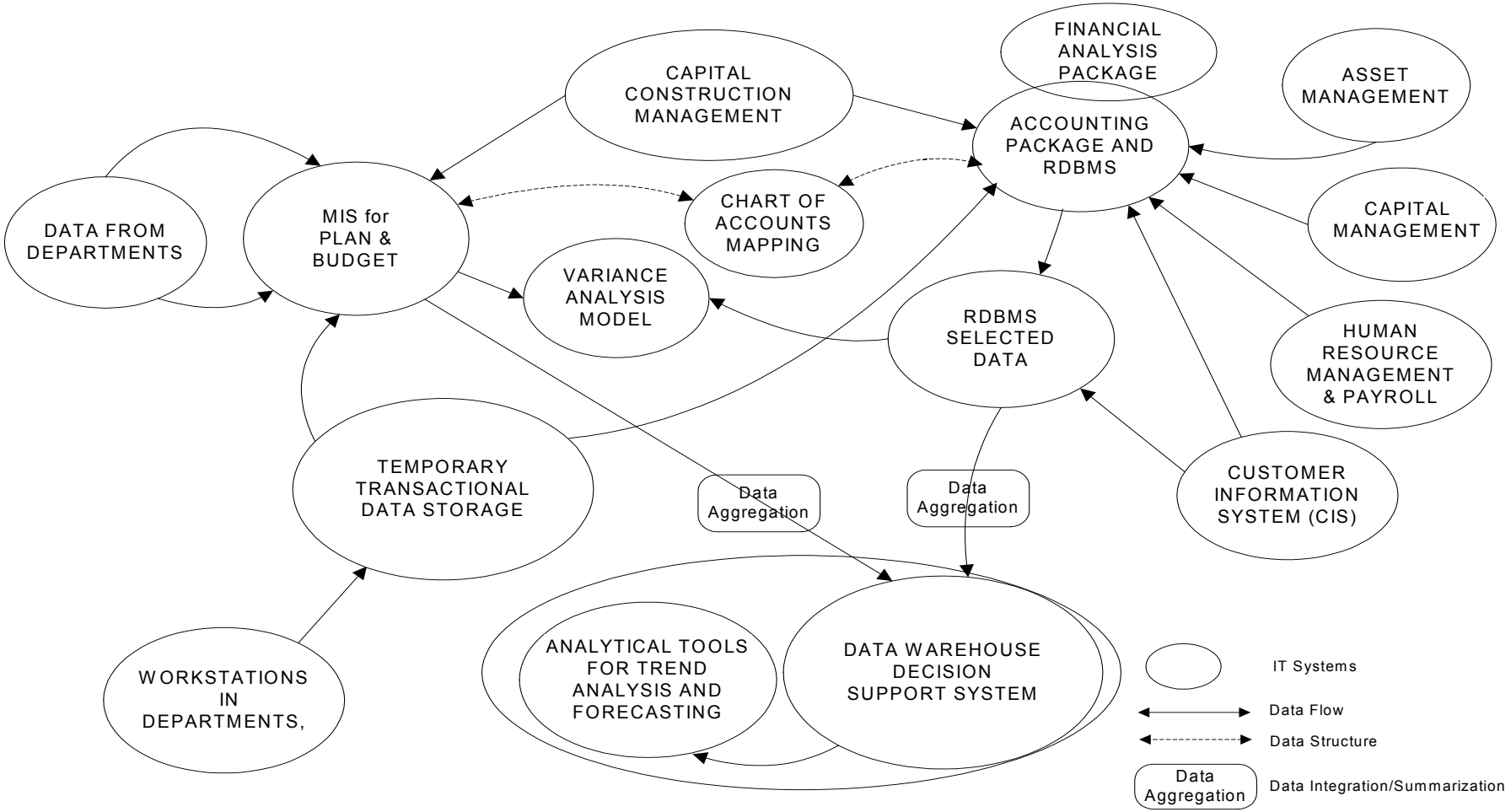
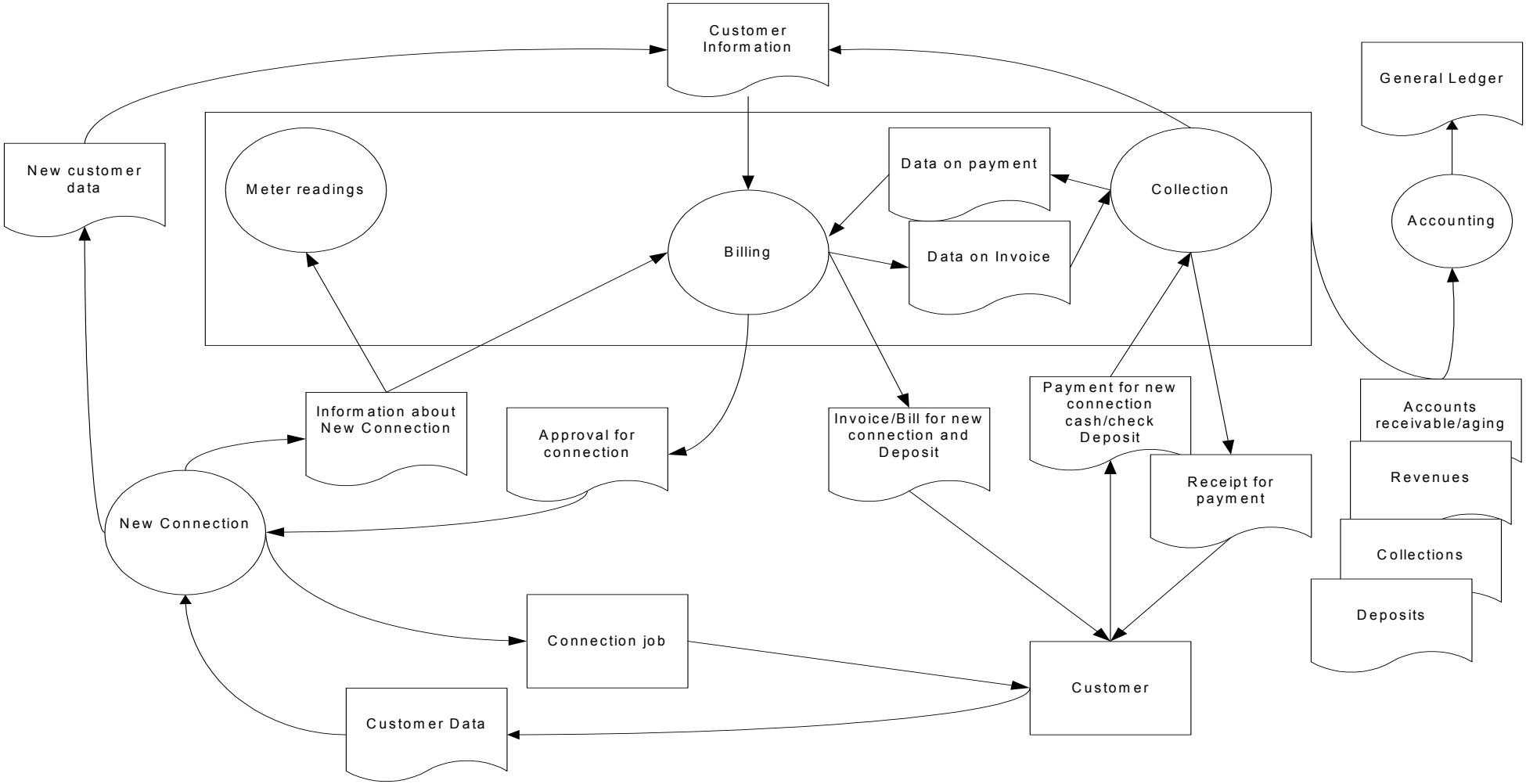


Figure 7-2 Data Flow for Customer Information System



and Baan are more neutral in design, whereas others such as MRO, Mincom, and now PeopleSoft orient their solutions to specific sectors such as electrical utility generation, transmission and distribution.

Several vendors offer smaller-scale integrated systems for small to intermediate-sized utilities. Examples include Municipal and Utility Package Software (MUPS) from Systems and Software, and Cogsdale's Customer Service Management CIS that has been integrated with Microsoft's Great Plains ERP system.

Many utilities have chosen to select "best-of-breed" billing systems and integrate them with limited enterprise solutions that do not have integrated billing systems. Examples of these more limited ERP solutions (i.e., without separate billing modules) are Microsoft's Great Plains Enterprise and NaVision Axapta, e by Epicor, and MAS 500 by Best Software. In some instances, utilities have selected separate components for all of their management information systems, including a billing system, and then integrated all the components with a technology called Enterprise Application Integration (EAI).

Numerous customer information systems (CIS) and standalone billing systems exist. One of the largest in the world is Peace Software. Orcom Solutions is also a major CIS player, but has now switched to on-line services only. Other major vendors of CIS systems include SPL Worldgroup, which also has a corporate EIA product for integration, DST International Billing with its HiAffinity product, and Gentrack of New Zealand which developed one of the first billing systems for deregulated utilities.

As indicated in the short discussion above, many vendors exist and utilities have many options available for developing management information systems. In this subsection we have expanded upon the elements of a typical MIS system for an electric utility and provided a short list of market leaders. In the remainder of this chapter we will concentrate on the billing system, a critical element for all utilities, whether in developed, developing, or transition economies.

Main Features of a CIS

Often times the terms CIS and CRM are used interchangeably. We will distinguish between the two systems in this report. As pointed out above, the CIS products concentrate on basic connection, disconnection, meter servicing, and billing functions. CIS products may also include functions designed to service customer relations (e.g., "CRM Lite"), but these features are generally limited in scope. A CIS is basically a billing engine.

Over the past half dozen years, many large utilities in the US and Europe seriously contemplated the implementation of fully functional CRM systems. Some CRM systems include billing modules, but most provide hooks to other stand-alone billing systems. Some utilities did implement fully integrated CRM systems, while others incorporated add-on systems to an existing CIS. However, due to the economic recession and the increased uncertainty in the US regarding implementation of deregulated environments, many utilities have delayed or cancelled the CRM system implementation.

We will not address the CRM products further, but will instead concentrate on how a CIS product can best serve a utility's core needs. Utilities throughout the world need CIS systems, but CRM products need customization to the specific conditions in a locality (e.g., extent of metering, density of population (rural or highly urbanized), road system, vehicle availability, communications infrastructure, cultural conditions, etc.).

Major Elements of a CIS
A customer information and billing system must track detailed information regarding personal customer data, sales, collections and receivables, and meter information. What follows is a summary of high level generic features for a "typical" billing system, that is, functionality and capabilities of the CIS.

- *Customer Information*: Personal data, account type, feeder and transformer information.
- *Meter Readings and Information:* Meter manufacturer, type, ratings, and factors, reading value and date, reading history, maintenance records including calibration.
- *Connections, Disconnections, and Reconnections*: List of customers to be connected for the first time, customers to be disconnected or face temporary shutoff for non-payment, and reconnection and dates for scheduled services.
- *Customer Invoices*: Company name, customer name and address, account type, current usage, tariff schedules, reading date, billing date and due date, aged debt, notice of disconnection if applicable and disconnection date.
- *Receivables Sub-Ledger*: Current, aged, and total receivables.
- *Payments and Receipts Modules*: Cash register, checks and bounced checks, payment types, prepaid amounts and partial payments, payment locations, credit history, receipt printing.
- *Cash Control and Reporting*: Cash books and daily cash reports.
- *Customer Security Deposits*: Amount, date paid, date refund is due to customer.
- *Customer Project Risk Deposits*: For large customer hook-ups non-refundable prepayment, refundable deposit, number of years to be credited against account.
- *Report Module*: Reports by account type, daily payments, daily breakdown by area/book, lists of clients with credit or in arrears, ad hoc reports, etc.
- *Portal to General Ledger*: Aggregated receivables and accounts due.

CIS Options for Developing Economies
Many different CIS systems are in use today. They range in scale, complexity and design from simple home-grown systems to large ERP systems. Some systems are designed for utilities in general and can be used for billing electrical, gas, water, and even telecommunications services. Others are oriented toward a specific utility sector. Most are designed to operate in a network environment, and newer systems go one step further and are web-based, thus allowing for on-line service. Some systems are designed for large corporations and based on Unix or large proprietary operating systems (e.g. IBM), although others are Windows-based systems. Some are oriented toward older billing systems and may still be based on flat-file systems such as dBase or Excel.

Billing system installations for large electrical utilities in the US have run into the tens of millions of dollars. If the billing systems have been included as part of a larger MIS, the costs can be even higher. We provide several specific examples as an indication of potential cost ranges for implementing integrated MIS and CIS systems.

Bids for an integrated financial management and billing system for a small utility in the Caribbean (5,500 accounts) ranged from $200K to $450K just for the software. Hardware and installation costs amounted to an additional $150K. Recent competitive bids for integrated

financial management and billing systems for a utility in Africa ranged from $500K to $2,500K. Several years ago a new billing system (CIS only) was installed for a utility in Africa with about 80,000 customers for $2 million. Professional services were also included in the design and installation phases of these projects. In these examples, the donors funded the projects, and commercial software systems were required. The cost of developing the system requirements and specifications are not included in the above implementation estimates, and maintenance and support are also generally priced separately.

A custom metering, information, and billing system was recently developed in the Caucasus by a major international energy company. The firm designed the CIS to address the local cultural and infrastructure environments. It took several years and cost several hundred million dollars to develop.

On the other hand, when donor or self-funding is not readily available, utilities may pursue other strategies to design and implement CIS systems. A utility can design a simple, yet functional, CIS system using local IT resources. The utility or local consultants could then integrate this system with an accounting and financial management system. Although such an approach would be cheaper in the short term, it may be more expensive over time, depending upon whether the utility wants to add more functionality, or upgrade to newer software technologies. Also, the company would need a core development staff to continuously update and modify the system (that is, no commercial upgrades would be available). Actually, a number of U.S. utilities have used this approach and used the legacy system for many years. The basic functionality of these systems is not that extensive, and as long as the system serves its primary function, that is, billing, then no compelling reasons exist to replace the CIS. Upgrades in operating systems may necessitate software upgrades, however, so this factor should also be considered.

Cost estimates for new CIS systems depend upon many factors and must be determined on a case-by-case basis. Only after a detailed assessment of the customer's existing organization and IT infrastructure and capabilities can a rational cost estimate be prepared. In the following section we present a number of factors that a utility must evaluate before an estimate for a "billing system" can be developed. Commercial vendors are able to utilize rules-of-thumb to estimate billing system software costs, but they will always address hardware and supplemental design services separately.

Implementation Processes and Issues

User Requirements
An evaluation of the customer's requirements is necessary before a system design can be developed and a cost estimate can be made. The customer's requirements can be determined in several ways. First, vendors can provide cost estimates based on bid documents from the utility containing system specifications. Even in this case it is prudent that a "sanity check" be conducted to ensure that the given set of specifications make sense. Alternatively, a detailed evaluation of the client's business operations and practices, and individual IT system requirements is necessary to allow for a cost estimate.

It is imperative to appropriately identify the system boundaries. In addition, utilities must consider the issues noted below. While at first glance many of these questions do not appear directly related to a CIS design, one must assess the complete situation to determine the scope of the billing and information development project, and the number and extent of supplemental design services required.

Factors Impacting System Design and Cost

- Is the utility undergoing restructuring, or is there an established organizational structure?
- Are the business processes and procedures clearly defined, or must this be part of the solution?
- Is an accounting and financial management system in place, or is a new one required?
- Are existing information subsystems integrated or best-of-breed?
- Are there requirements for integration with other systems?
- Are the accounting and billing staff adequately conversant in modern IT technology, or will they require a significant amount of training to provide fundamental IT skills?
- How many staff members will be involved in training programs?
- Is there an adequately trained IT staff available?
- Is there a legacy system from which data must be imported? If so, is the legacy system built with current or obsolete technologies. Is source code available?
- Is there a critical timing constraint that may impact staffing plans and data conversion efforts?
- How is the new CIS implementation being funded (impacts risk)?
- Have terms of reference been prepared for an international tendering process, or must the system specification be developed?
- Will the billing system be situated in one location, or will the system be distributed?
- Will the system have adequate physical space, or will it require building renovation to accommodate air conditioning, new electrical wiring, etc.?
- What level of reliability is desired (e.g., will a RAID system be required, and, if so, what level)?
- What type of backup system is required?
- How will data be gathered – manual meter reader, automated meter reader devices for walk-by data collection, or remote reading system for drive-by collection or electronic data collection?

It is evident from the range of items listed above that in many instances a CIS system cannot be developed “in a vacuum”, but must be integrated into a broader corporate strategy or program.

Specifications of Hardware and Software
After careful evaluation of the issues impacting the CIS system design and implementation, a set of user requirements is first established, upon which a detailed set of specifications can be developed.

Procurement Process
Large information technology supply and installation projects are typically conducted using international competitive bidding procedures such as those developed by the World Bank (WB). The WB has developed special IT procurement procedures because it considers large information system projects to be among the most challenging procurement projects. IT projects differ from standard goods procurements because they are very risky from a supplier’s

perspective, and often require complex installation and support services. These two features of IT procurement necessitate special evaluation and contracting terms.

Among the challenges related to large IT projects are:

- Technical content that is difficult to define
- Highly changeable operating environment (business objectives, organizational politics, and institutional capacity)
- Rapidly evolving technology over the project life cycle, and
- A need for professional business and engineering services combined with the supply of complex hardware and software

The World Bank has developed specialized, standard bidding documents (SBDs) to facilitate IT procurement on projects funded by the Bank. The SBDs provide models for bidding and contracting to support procurement, installation, integration, operation and maintenance phases of a large project. There are two basic SBDs, each with a different approach to arriving at an acceptable bid and contract. They are:

- Standard Bidding Documents, Supply and Installation of Information Systems, Single-Stage Bidding (June 2002)
- Standard Bidding Documents, Supply and Installation of Information Systems, Two-Stage Bidding (March 2003)

In the single-stage approach, the SBD includes a highly detailed set of technical specifications and bidders are expected to meet these specifications with little or no flexibility in the approach. In the two-stage approach, a more general set of user requirements is defined, and bidders are allowed more freedom in the approach. In the case of a CIS solution, the single-stage bidding process is more appropriate because the requirements, and therefore technical specifications, can be defined concisely.

Under USAID funding an IT supply and installation project may be a component of a larger program, and there may be more flexibility in procurement approach. For instance, the contractor may in fact have the skills to design and implement a CIS system. Or it may design the project, and request bids for supply and installation. In the latter instance the competitive bidding process may be less onerous than under WB procedures (although prudence would dictate that similar procedures and guidelines be used).

Generally, the major steps involved in a procurement using a single-stage bidding process for a CIS system are:

- User defines requirements
- User develops system and component specifications based on user requirements
- User prepares bidding documents containing the following:
  - Invitation for Bids
  - Instructions to Bidders
  - Bid Data Sheet (contains critical bid information)
  - Eligibility for the Provision of Goods, Works, and Services (for example, source and origin guidelines)

- General Conditions of Contract
- Special Conditions of Contract (customized elements)
- Technical Requirements and Implementation Schedule
- Sample Forms including Form of Contract Agreement

- Bids are evaluated per prescribed steps in the SBD, and contract is awarded
- Supply and installation phase (per the technical requirements)
- Testing (including acceptance testing by the purchaser)
- Warranty support
- Longer term maintenance and support

CIS Installation

The previous section outlines the overall design, bidding and installation process. The installation process itself may range from relatively simple (for installing a new CIS in a small utility), to very complex in a larger organization where a legacy system exists and significant customization is required. We briefly describe the major steps below, with the understanding that the bidding process has been completed and specific actions are determined on a case-by-case basis. The project plan will specify the sequencing of the individual elements.

- **Project Plan:** A project plan detailing the main elements, staff, and schedule is developed with the customer's support and approval.
- **Hardware Procurement and Installation:** If the procurement includes new computer equipment, it is ordered quickly and installed as soon as possible. A new operational network may be installed, or an existing one may be augmented. Long lead-time items such as line printers should be ordered as soon as possible.
- **Software Procurement and Installation:** Operating systems, database management systems, and standard customer information application software is ordered and installed as soon as the computer equipment and network are available. Frequently, several versions of the database are installed – a "test" version and an "operational" version.
- **Customize Application Software:** If the procurement includes customization (the utility should attempt to minimize this need), it should be done early. The customization may be done either at the vendor's manufacturing facility or on-site, as appropriate. Customization may impact both functionality and reporting.
- **Develop a Test Database:** After the standard customer information application has been installed it must be tested. A set of test data must be developed and loaded into a test version of the application software.
- **Integration With Other IT Systems:** The software vendor performs integration programming and testing.
- **Testing Application Performance:** With the test data loaded, the vendor must run a suite of tests to verify operation of the system.
- **Acceptance Testing for CIS:** The purchaser retains responsibility to develop a set of data oriented to local conditions and a suite of acceptance test programs. After successfully completing the acceptance tests, the purchaser will approve the application.

- **Data Conversion Methodology:** If the utility needs data ported to the new system from a legacy system, the vendor will develop a procedure to export data from the old system and import it to the new system. Automation is a key objective, especially for very large customer bases.
- **Data Population:** At a particular time a “snapshot” giving the state of the system must be taken, and the data from the legacy system transferred to the new system. The purchaser should work with the vendor on this critical task.
- **Data Cleaning:** This is another critical stage that requires the customer’s full attention. The purchaser knows his customer base, and must clean the data in the new system.
- **Operational Testing:** After loading the customer data into the test database, and the data cleaning process has occurred, the purchaser will need some time to operate the test system. The vendor should continue to be available throughout this period to provide assistance.
- **Parallel Operation:** As the operational testing proceeds, the utility will continue to use the legacy system for business purposes. At least one month, and preferably several months, should be allowed for this phase. It is incumbent on the purchaser to have adequate staff available to operate both the legacy system and the new test system.
- **Acceptance Test for System:** The purchaser may wish to prepare additional tests to verify that the functionality and operational performance of the new system is acceptable per his requirements. After the purchaser is satisfied, he will execute an acceptance certificate for the system.
- **Communications Systems:** Most systems will be implemented in multiple locations. This distributed nature of the system may require special networking and communication accounts to be installed and established.
- **Training (and Retraining):** Capacity building is a critical element of the overall installation process. If the IT staff requires basic IT training, this must be done early in the project. On-the-job IT training continues throughout the project. Training courses for the operational staff, as well as their managers, is critical. The staff must not only understand their specific duties, but should understand the overall system so they can perform their jobs more effectively and identify problems that might arise. After the operators have been running the system for a period of time they should be given a refresher course.

Lessons Learned

Only through experience working in developing and transition economies can one appreciate the numerous issues facing system integrators and software developers in those environments. Not only are the issues often different from those faced in similar projects in developed countries, in fact, the issues encountered in transition economies are also different when compared to those in developing countries.

Large-scale information system design and implementation projects in developing countries have been relatively limited in number and have occurred only within the past decade. Most of the larger financial management systems have been financed through donor funding (World Bank), and a few smaller systems have been self-funded by the implementing ministry or agency. Several small-scale projects, including customer information systems, have been supported by USAID.

We summarize below lessons learned from implementing management information system projects. Recently, the World Bank funded a review of five Integrated Financial Management Information Systems (IFMIS) projects implemented in Africa since the mid 1990s.[9]. Although central government IFMIS projects reviewed by the Bank are not identical to the CIS under consideration in this report, there are numerous similarities in scope and process. The WB paper presents six key lessons (and accompanying recommendations), which are generally consistent with experiences gathered by USAID consultants on IT related activities.

Corporate Buy-In Is Critical

Independently of where an IT project is implemented, a key factor in its success is the degree of support provided by corporate management or the political establishment. Even with corporate buy-in, implementation of complex systems is difficult, and without executive management support the project is guaranteed to fail. This holds true as much for IT projects as for other institutional development and infrastructure development activities.

The first test of commitment is to determine who is requesting a new CIS or MIS and why. It is a good sign if the request is from the ministries or corporate departments who wish to improve the financial performance of the electrical utilities. If the development of a new CIS is purely donor-driven, then chances for success are slim.

The historical experience of the country or region is another indicator of potential success. For example, in Anglophone and Francophone countries in Africa, the colonial heritage provided a foundation in regulatory and institutional frameworks and in financial management procedures. Although the fundamentals were well understood, the major problems have been a lack of formalism and a failure to follow established rules. Corporate vigilance is necessary to ensure that procedures are followed and the systems are operated as intended.

Not only must the executive management be the initiator of an IT system upgrade, it must understand its project responsibilities. Management must actively participate, not simply approach plans and budgets. As an example of inadequate involvement by upper management, a USAID project in the Philippines in the mid-1990s was intended to (1) provide assistance to enhance a department's infrastructure (network, computers, and software) and (2) to create and implement a decision support system to assist the ministry in developing long term energy programs. The first objective was technical in nature and was accomplished. The second objective, however, was not met because the department leadership would not actively engage and define its information requirements. It expected junior level staff and IT developers to develop the system requirements and then simply hand over an operational decision support system. Unless at least one senior level manager becomes a champion for a project and takes ownership, it is unlikely that the project will be successful.

Design and Implementation Advisor Is Key Factor

Several recent reports by the Energy Planning Network's (EPN) Utility CIS/CRM Consortium reported that the selection of technical advisors is as important as the technology itself. This applies to consultants that may be selected either to design the system or to assist with installation. In international development work conducted under WB auspices, a two-step process is often used whereby the purchaser selects a consultant to assist in the system design and bid process. This consultant may also oversee and assist in the installation process, or a

[9] "Design and Implementation of Financial Management Systems: An African Perspective", Africa Region Working Paper Series No. 25, January 2002.

separate consultant may be selected during the procurement process to provide installation assistance.

Consultants hired by the purchaser must be allowed independence to develop a reasonable scope of work and to recommend adequate resources to implement those terms of reference. If the resources are underestimated, then the purchaser may be surprised by the bids that are received. Of course, the consultants must have experience that is appropriate for the job.

USAID has yet to undertake a large-scale CIS design and installation project. It has supported some small-scale systems under larger umbrella contracts. Under most large contract vehicles USAID has not envisioned the need for major IT projects and generally has not required the IT skills that would be required to monitor or implement such projects. If CIS implementation is contemplated on major projects then either the prime contractor, or one of the major subcontractor partners, should have access to experienced senior IT experts.

Project Scope Requires Adequate Definition

A properly defined scope of work is probably the most critical element in the overall process of designing and implementing a CIS system, or a more encompassing integrated financial management and billing system. If the main goal of a project is to implement an IT system, and a structured approach such as that used by the World Bank is used, then the danger of an inadequately defined scope for an IT system is minimized. However, in most USAID projects, IT system development is not considered to be a major goal, although IT systems may be included in project design as enabling elements. If the IT system is only seen as a support tool, then the chance that adequate terms of reference will be developed is poor.

It is critical to give adequate attention to this phase because a good assessment early in the task should provide a reasonable cost estimate. This information will allow project management to determine whether adequate funding is available to continue with the system development. It is better to assess this early rather than learn later that funds are insufficient.

Reform Process May Be Required

Depending upon the IT project under consideration, system reform may or may not be necessary. For instance, in the IFMIS projects evaluated by the World Bank in Africa, major reform programs were required to strengthen the institutions, systems and processes dealing with public finance. CIS system implementations in Africa and Asia have not generally required this, however. As long as the country or corporate utility has adequate accounting and financial management systems in place (International Accounting Systems are widely used in Africa and Asia) a CIS can be implemented and linked to the accounting system. Business processes may require modification, but overall reform programs may not be necessary.

In some locations, major reform programs are a prerequisite for something as seemingly straightforward as a billing and collection system implementation. For instance, in the former socialist countries in Eastern Europe, western style financial management systems simply did not exist, and consequently, a major institutional reform process, including the development of a functioning legal system, must be undertaken first. Only after the concept of budgets and expenditures based on market principles has been accepted by the country and/or corporation will it be possible to implement supporting systems such as billing and collection.

As an example of challenging conditions for CIS implementation, consider Georgia. USAID has a new energy security project which includes a task to manage the United Distribution Company (UDC) on an interim basis. The UDC distributes electricity to most regions in the country,

excluding the capital. In the former Soviet days, the populace was not expected to pay more than a nominal fee for services such as electricity, and the UDC never had a billing and collection system per se. The UDC did collect nominal fee amounts, but they were often used to support local government needs, not pay for generation, transmission, and distribution services as in a western system. Now, as Georgia moves toward a market economy, a functioning electrical sector is required to provide electricity and foment economic growth. In order to cover operating expenses and pay salaries for employees, UDC now requires a billing and collection system to cover the full cost of providing the service. While implementing a physical CIS system may not be particularly difficult, the new concept of paying for electricity requires a change in attitude on the part of the populace. It may also require government policies designed to subsidize the cost of electricity, at least for the impoverished segment of society.

India provides another example where reform processes may have to precede widespread CIS implementation. The country has a general policy of subsidizing agricultural water pumping, which is a major electricity consumer. Again, the issue of cross-subsidies and tariff design is probably much more difficult than implementing billing and collection systems. Regulatory reform on a state-by-state basis in India will be a major challenge.

Establish Priorities and "Think Small"

After establishing an overall work plan and schedule, priorities should be established so that the most critical elements begin first, possibly as separate subprojects. Large complex projects, whether in developing or developed countries, have greater potential to fail than smaller, more focused and manageable subprojects.

Several risk factors associated with large projects follow:

- *Complex projects are difficult to manage:* They require strong leadership and project management skills to coordinate many stakeholders.
- *Complex projects are expensive:* They require substantial investments in hardware, software, and infrastructure.
- *Complex projects may not produce results in a short timeframe:* Large projects take years to complete, and commitment may fade if periodic results are not noticeable.
- *Complex projects have a higher risk of delay and failure:* Interdependency of components and subprojects often result in domino effect problems or delays.

To mitigate the risk associated with a large and complex project, it is appropriate to break it up into phases. As much as possible, self-contained phases or subprojects are desirable. Utilities should rely upon benchmarks and milestones to assess the success of the individual phases. The following examples illustrate ways in which complex projects can be subdivided into smaller, more focused and manageable components:

- Projects may be separated into phases such as design and bid, and then procurement and installation.
- A separate phase may involve business process review and adjustment.
- Implementation may be phased so that a main billing system is installed in the corporate headquarters first, and then smaller components may be rolled out to remote service territory regions.

Business Processes Must Be Right
Commercially developed customer information systems are designed for a typical electrical utility. The goal of a CIS implementation should be to minimize system customization, although some may be appropriate. A key part of the overall design process, then, will be to match the workflow and functional data flow in a CIS system with the organization's actual business processes. Therefore, reviewing and mapping the utility's business processes is an important first step. "Change management" expertise is important during this step to ensure efficient workflows. In addition, it may be desirable to modify some business processes to more closely match the CIS application design. Generally, a utility should not require software changes simply to meet a business practice familiar to the work force, especially if that practice can be modified in a reasonable manner. Software customization will not only slow down the installation, but will create problems in the future when the utility wishes to update the application software.

Technical Choices are Important
The design and implementation of a successful billing and collection system depends on many factors, such as those identified elsewhere in this section. These factors drive the system requirements which, in turn, impact the choice of software and hardware components.

A thorough analysis of the business processes, workflow processes, data flow, number of users and their locations, number of accounts, need to integrate with other information systems, etc., will result in a set of user requirements. This analysis is generally led by consultants, but must be done in collaboration with the system users and managers.

The functionality of commercially available CIS systems is quite standard. While there may be special local needs, most user requirements will be met by various commercially available "off-the-shelf" application packages. Most CIS applications contain many user definable parameters, and can accommodate most special needs through parameterization or software package customization. As stated previously, it is best to minimize the amount of customization. Such software modifications can present challenges when upgrades are desired.

The CIS hardware components are also partially driven by the user requirements analysis. For example, the number of accounts and the number of years' worth of data to be stored on-line will impact the size of disk drives. However, it is also important that the computer hardware be compatible with the application software. For instance, the type of database used may influence the size of the memory and disk(s). Most software developers will provide a set of specifications for computer servers and/or workstations, and they will often certify specific computer models. Because software developers often recommend hardware, it may be preferable to combine computer hardware and software into a single procurement.

Local area networks (LAN) are universally available. Wide area networks (WAN) may pose a more interesting challenge in developing countries, however. High-speed connections are not widely available in many developing country locations, however, making data transfer via diskette, tapes, or CD-ROMs a necessity. The user requirements will have to fit available resources. In some instances, the government may establish its own wide area networks for privacy or secrecy purposes.

Capacity Building is Essential
The IT skills in the sector should be carefully assessed. Networking and computer setup and operation skills are insufficient. It is also important to have domain skills available. If installing a billing system, the utility will need staff with IT skills and billing systems expertise. Similarly, if

implementing a new accounting and financial management system, the utility will need staff with both accounting and IT skills.

Because of the popularity of software and IT systems development, it is relatively easy to find networking and general IT skills in developing countries. There is generally a shortage of critical domain skills, however. The most desirable solution may be to train knowledgeable domain professionals in IT technologies. At a minimum, both IT and domain experts should be cross-trained in the skills required to install and maintain a modern customer information and billing system.

A major problem in developing country environments is the difficulty in retaining highly qualified technical staff, especially if the utility is a government ministry or department. Typically, the pay in these organizations is well below that in the private sector. When a staff person is trained in an IT technology he/she immediately becomes a valuable commodity in the private sector. Some organizations have tried to execute and enforce agreements in which a person benefiting from a government-sponsored technical training program will remain in his position for a given period of time. A better approach to retain qualified personnel is to raise the pay scale, if possible.

The skill level of the utility staff in general must be assessed early in the project. This applies to the billing and collection staff, accounting/finance staff, data entry operators, as well as the IT staff. All utility staff who will be involved in managing or operating the system must receive CIS system training. The best approach is to provide training off-site to capture the full attention of the trainees. Depending upon the system, this could take a week for data entry clerks, to several months for those responsible for operating a large ERP system. Extensive dedicated training is seldom possible, however, because the staff will also be responsible for daily operation of the legacy system. Hands-on training must be a key element in any training schedule.

Another factor to consider is the availability of local community skills for support. Local IT services should be an integral part of a long-term operational plan. The local maintenance organization should be involved in the installation process so that it can provide support once the primary consultant has completed its installation services.

Underestimating the Cost of Installation

The cost of any complex IT system will depend upon the specific details of the situation. We provide some general cost information, but only as a planning guide and as a check on vendor or consultant estimates. First, we provide guidelines for customer information and billing systems. Then, we provide additional cost information for developing large accounting and financial management systems. This information may be useful if a utility is contemplating replacing a complete management information system, including accounting and financial management.

Complex IT project installations often face cost overruns, so utilities must pay attention to the quality of the cost estimates provided by consultants or vendors. Frequently, the original cost estimate is deliberately optimistic to obtain project approval. In other instances, unforeseen complications arise during installation. Cost overruns result from a multitude of problems, including failure to account for business process changes, integration problems with other IT systems, delayed delivery of system components, staff changes, political unrest, performance problems with local subcontractors, delayed installation of communications channels by either

private or public carriers, poorly defined or changing user requirements, uncooperative operators, data conversion problems associated with “dirty data”, etc.

Customer Information and Billing Systems
The cost of billing and collections systems is comprised of numerous elements including:

- CIS application software
- Database engine used by the CIS
- Computer hardware and networks (LANs and WANs)
- Customer user requirements review and gap analysis (identifying areas where the CIS software does not meet user requirements)
- Customization (if required by the gap analysis)
- Report customization
- Parameterization
- Network installation and testing
- Application software installation and testing
- Data conversion analysis and software development if necessary
- Data conversion from legacy system to new system
- Data cleansing
- Training (pre-installation and on-the-job)
- Operational support for a limited time

In the US and Europe there are three basic types of CIS systems being implemented today. They are:

- *In-House Managed Application*: The purchaser licenses the application software and buys hardware and services from a vendor. The purchaser also invests in staff payroll and other out-of-pocket expenses.
- *Hosted Application*: The purchaser licenses the application software and the system is hosted on third party equipment. Installation costs are less, but per user operating fees are charged.
- *Outsourced Application*: The entire system is outsourced to a third party (who owns the hardware and software license), and the system is generally located in the purchaser’s facilities. Monthly operating fees are applicable.

In most developing or transitional economy environments only the first option is feasible. Table 7-1 shows the costs associated with these three installation types, as provided by a leading independent CIS consultant in the US.[10] Costs and financing terms are important in determining the annualized costs per customer.

[10] CIS Pricing Considerations, Greg Galluzzi, UtiliPoint Issue*Alert* Emerging Technologies, September 2003, www.cisworld.com/articles/index.html.

Table 7-1 – CIS System Procurement and Installation Costs

CIS Application Type	No. of Customers	Total Vendor Costs[1]	Buyer Direct Expenses[1]	CIS Software Cost[1]	Total System Cost[1]	Monthly Operating Cost[2]
In-House	100,000	$20-$30	$5-$20	$3-$7	$25-$50	$0.15-$0.30
Hosted	100,000				$22-$45	$0.13-$0.25
Outsourced	100,000				$15-$30	$0.50-$1.50

Notes: 1) Installation costs are given on a per customer basis.
2) Monthly operating costs are given on a per customer basis.

Because of the many aspects involved in developing a new CIS system, purchasers should be wary of relying solely on the per customer application software cost. Comparing the average installation cost per customer to the average cost of the application software per customer will provide very illuminating information. A factor of ten is not unusual.

A recent commercial CIS installation in Africa under World Bank funding cost $1.5 million. The customer base was 77,000. The average cost per customer was $20 per customer, which is consistent with the "total vendor cost" information above.

In a recent procurement under Caribbean Development Bank funding, the bids received were even higher than the averages shown in Table 7-1. One bid that included hardware as well as software and installation costs was $85 per customer. Several other bids, which did not include hardware costs, ranged from $25 to $35. It should also be noted that small systems such as this tend to be more costly per customer. In this case, none of the bids were accepted and a revised strategy using international shopping rules is being purchased.

Accounting and Financial Management Systems
Following is data taken from the recent World Bank Africa Region Working Paper Series No. 25. This document provides insight into the cost of large public accounting and financial management systems. The scopes of the projects were not identical – all included installation of medium to large-scale accounting and financial management systems (Oracle, CODA, Platinum), and the degree of reform and business process adjustment varied. The actual costs, or projected costs for on-going projects, ranged from $5 million to $15 million. The Bank report indicated that some of the values were artificially low because some elements such as training, buildings rehabilitation, LANs and WANs installation, and project management were not budgeted and tracked. It is not clear whether these costs include large amounts of foreign consultant time or reflect heavy local involvement, and therefore cheaper labor.

A recent DFID report[11] estimated the implementation cost of a "core budgeting and accounting system" to range from $10 million to $20 million. These systems do not include large operational systems such as utility billing and collection systems.

Continuous Presence During and After Installation
It is imperative that one or more implementation specialists must be on-site continuously during the installation process. This will be required for at least 6 months for a medium-sized

[11] Understanding and reforming public expenditure management, Guidelines for DFID, Version 1, March 2001.

installation. The consultant should also be from the local community or a neighboring country rather than an expatriate from the US or Western Europe. He/she must understand local culture and language and be able to work well with the utility staff. The person must be on-site continuously for at least several months after commissioning. As an example, in a CIS installation in Malawi, a consultant from South Africa was stationed on-site for six months after the client accepted the system.

The presence of a consultant on the purchaser's premises also provides the opportunity to conduct additional training after the staff has had an opportunity to work with the system for several months. A second, or even a third, training session is time and money well spent.

Support After Commissioning
There should be a provision for continuing maintenance and support for a minimum of three years, possibly longer. The utility must maintain equipment during the hardware warranty period, and ideally, should also make arrangements for local support after that period. Software must have a warranty period of at least one year, and there must be provisions for software support for several years after that. The local staff will forget things that they do not encounter often, so a good plan will include an annual "health checkup" and refresher training. Support must be available via telephone and on-site if necessary.

Experience in the recent Malawi CIS implementation project has shown that inattention to formal procedures can create serious problems. When data is not entered in a timely manner and adjustments are not made according to good accounting practices, the database can become so corrupted that serious problems may occur during the preparation of annual financial reports. In Malawi, the utility did not process cash receipts on a daily basis as required, making it almost impossible to conduct balances. The database had crashed several times and backup procedures were not strictly followed. A consultant from South Africa has been supporting the customer since the installation in 1999, but even his familiarity with the system was not sufficient to correct some of the database problems.

Case Studies

Through several case studies below, we seek to demonstrate the scale and diversity of installations that one finds in developing countries and emerging economies. Each system is unique, reflecting the individual country or company requirements. These requirements are driven by law as well as culture and custom.

There is no "cookie cutter" approach that will fit all installations. Each system design and installation will require expertise in distribution company operations, software design and installation, and hardware and networking skills.

Armenia (USAID)
The electricity distribution system in Armenia has undergone significant changes over the past eight years.

- In 1996, 63 separate distribution companies existed.
- In 1999 the system evolved into 4 distribution companies consisting of 63 branches.
- In an attempt to further consolidate the distribution sector, the 4 distribution companies were combined into a single national distribution company in the Summer of 2002.

- Finally, in November 2002, there was an additional transition from a single state-owned company to a privately owned distribution company.

In an effort to assist the Armenian government after the power sector was unbundled in 1995, USAID sponsored restructuring programs to improve the financial performance of the power sector. As part of this overall effort, USAID funded a small pilot program to demonstrate ways to improve branch operations. The effort included a basic billing system for customer information, billing, collection, and loss detection in small distribution companies. The metering, billing and collection system was named ABACUS (Armenian Billing and Collection Utility System).

Technology:
The ABACUS system was developed in the late 1990s using relatively simple and available low cost tools. It used the Sybase relational database management system, and the front-end user interface screens were developed using the Sybase PowerBuilder integrated development toolkit. The system was designed to run on relatively slow computers available at the time.

Some of the main functional features of the ABACUS software include:

- Creates a customer accounts database
- Supports customer queries regarding account status
- Defines meter reading schedules and routes
- Tracks customer electricity usage (meter readings)
- Prepares customer bills using single or multiple tariff schedules
- Records customer payments
- Monitors account receivables
- Creates a meter testing and replacement schedule
- Produces standard reports for accounting and technical information
- Creates a “PowerFLow” distribution tree of the customer database to assist in identifying commercial and technical losses.

The last item is one of the key features of ABACUS. In Armenia, as well as in other former Soviet Union (FSU) countries, the transmission and distribution systems are not well designed for monitoring and controlling electricity flow. This is a consequence of the different design concept prevalent throughout the FSU. The state, the owner of the electrical system, was seen as a service provider and the populace had a right to receive electricity at little or no cost. Because individual payments for electricity were not required, the system could be designed with little thought given to end-point metering. Entire communities shared a connection to a single feeder or transformer point with no individual meters. Un-metered “back-door” distribution circuits from power plants were commonplace. The concept of sub-customers, where a neighborhood could receive power from the low voltage side of large transformers owned by industry or by large budget (government) agencies, was very common.

With the advent of privatization, the existing distribution/transmission system creates difficulties for the billing and collection functions. Ultimately, the majority of customers will have to be metered or re-metered. In the meantime, the utility must implement other methods of recovering production and distribution costs. Community-based collection systems, where all customers

share the cost of electricity independent of the amount they use, will remain in place for a while. Even in these cases, control meters must be installed on feeders.

Distribution trees showing the main high voltage substations (transmission system), distribution substations, transformer substations, and feeders to end-point users allow the distribution companies to analyze energy flow to determine where significant technical and non-commercial losses occur. Armed with this information the utility companies can then search for reasons for the "leakages", that is, detect technical losses and identify specific instances of theft.

ABACUS Implementation Experience:
The following case study describes the effort to install ABACUS in distribution companies in Armenia. The basic application program was also installed later in Georgia in modified form (refer to the Georgian Case Studies later in this chapter).

Genesis of the Armenian distribution companies:

- In 1996, there were 63 distribution companies.
- By 1999, there was an evolution to 4 distribution companies (with 63 branches); most branches had residential customer bases ranging from 10,000 to 20,000.
- In the Summer of 2002, the 4 companies were combined into a single distribution company.
- In November 2002, there was a transition from one state-owned to one privately owned distribution company.

Case study – ABACUS MB&C (Metering, Billing and Collection)
(Armenian Billing and Collection Utility System)

ABACUS implementation

- In1999, ABACUS was installed in 2 of the 4 companies
- In one of the companies it was installed in 5 branches
- In the other company it was installed in 1 branch

Technology

- The current system is DOS-based Clipper
- The original developer (company employee) would not give the source code to the utility
- The developer quit and then returned, and offered to sell the source code to the company

Results

- The branch managers in both of the distribution companies ignored the ABACUS software and continued to use pre-existing processes and procedures.
- In October 2002, the distribution company in Yerevan asked for the ABACUS billing package. It purchased a server and workstations and had the ABACUS software installed. However, they did not commission the system and did not transfer existing data from the old system to ABACUS.
- In July 2003 the recently privatized Yerevan distribution company ported customer data into the new billing system. However, they did not run system acceptance tests and the system was not commissioned. The IT manager in the company was in the process of developing his own software package (based on very old Clipper and DOS technology), and wanted to sell it to the distribution company.

- Lack of buy-in by the distribution company's line management and the Ministry of Energy meant that, although a usable billing tool was available, there was no guarantee that it would be implemented in the distribution companies.

- Use application software with transparent processes increased the collection rate. During a two-year monitoring period the total collection rate for all customers (residential and commercial) increased from 72% to 86%.
- Lack of computer skills in the distribution companies meant that network operations and system backup were a problem for the local companies.
- Unfamiliarity with basic computer systems required a strong training program. This was not a major component of the development and implementation program.
- Unreliable electricity supply means that the computer system is unavailable during extended periods causing significant delays in the billing process.
- Finding qualified software developers in many FSU countries is difficult. There are computer literate people with experience in Microsoft Windows and the entry-level MS Access database, and some with a background in high-end systems such as Oracle. However, experience in Sybase/PowerBuilder technology is very limited.

Malawi ESCOM (World Bank)

In 1999 the national Electricity Supply Company of Malawi (ESCOM) decided to utilize part of its World Bank power sector loan fund to install a new billing and collection system. A supply and installation project was designed to replace an early-1980's billing system that was not Y2K compliant. The old system was Unix-based and was operational only in the ESCOM corporate headquarters office.

PA Consulting Group (then Hagler Bailly) won the bid to assist ESCOM design, install, test and commission a $2 million Y2K-compliant customer information and billing (CIS) system. The basic system was successfully installed in less than six (6) months, and became operational before December 31, 1999 as required. ESCOM began billing with the new system in January 2000. Acceptance testing, report format tailoring, custom report development, and training continued until full supply and installation certification was provided by ESCOM in June 2000. At that time, a 4-year warranty period began. During the warranty period PA must provide annual on-site technical assistance and training, as well as hardware maintenance support.

Technology and Architecture:
A commercially available CIS software package called Custima (provided by DST Innovis) was customized to meet local requirements for tariffs, reports, and remote off-line operations. The system was designed to reside in three separate electricity distribution regions. Data was to be transferred initially via diskette or tape until the three locations could be connected electronically via high-speed data lines. Although some progress has been made with installing high-speed data lines, the data transfer still relies upon physically transporting tapes, and dialup telephone lines.

The version of Custima was a DOS-based software package. PA selected a DOS system over a Windows-based system for several reasons. The DOS-based Custima system used fewer computer resources, and the user interface screens were similar in "look and feel" to the older 1980's DOS-based system. Therefore, it was felt that this would minimize the amount of training required to transition from the older system to the newer one. Also, the DOS-based application was more stable than the Windows application, and it was cheaper—a major consideration for one of the poorest nations in the world.

PA selected Custima because this software was installed in numerous places in Africa, and a good consulting firm in South Africa served as the regional representative for the Custima product. PA used the South African firm during the installation process and has continued to rely upon its services throughout the maintenance period.

The system was implemented on a Windows NT operating system. The hardware system consisted of two mirrored servers in Blantyre and one server each in Lilongwe and Mzuzu. Separate LANs operate in each of the three locations, and dedicated telephone lines serve to transfer data between the sites. A total of 32 network workstations were supplied, as well as six high-speed line printers and other smaller peripherals. Billing/cashier workstations were provided for 20 rural revenue offices which operate in batch mode with daily uploads to the three main servers (via telephone or diskette). All customer billing and information records within the system are maintained in a Progress relational database management system.

The utility had been using a very cumbersome customer hookup procedure for connection and disconnection services. We redesigned this process to decrease the time needed to connect new customers. We also slightly modified the data entry and billing process to take advantage of improved techniques within the Custima program.

A key element of the project was an extensive training program for both system administrators and for users (accountants and data clerks). Each course was several weeks long. The courses were conducted prior to system startup, and the user course was then repeated after the users had a chance to work with the system for several months. A consultant from South Africa was resident in Malawi for about 8 months to provide on-site assistance (Custima expertise was not available within the Malawian technical community).

During the past year ESCOM has contracted with a South African firm to implement a hand-held automatic meter reading (AMR) subsystem. Implementation of the AMR will accelerate the meter reading process and will eliminate numerous data entry errors.

The specifications for the commercial billing system implemented in Malawi were typical of the many systems available on the market. The version installed in 1999 did not contain a CRM subsystem as it was not required by the client, per the bid documents.

We summarize the major CIS system requirements below (some are unique to the Malawi environment).

- Customer Billing:
  - Interactive data entry and editing
  - Automatic bill calculation and printing
  - Capability to handle multiple types of accounts and tariffs
  - Managing new connections and monthly installment payments
  - Statement and bill reprint on demand
  - Must produce meter reading sheets
  - Support on-line queries and allow updating of consumer data
  - Statistical and control reports
  - Management of account terminations
  - Management of disconnections/reconnections for unpaid bills

- Receivables:
  - Receipts processing from multiple locations
  - Recording of receipts and refunds and customers deposits
  - Receipts for connection and reconnection
  - Cash and check receipt management
  - Receipt printing upon demand
  - Automatic receipts credited to customer's account
  - Management of sundry receipts
  - Detailed end-of-day processing and reporting of cashiers' summary and bank deposit listing
  - Disconnection listings
  - Detailed consumption analysis reports
  - Charges for capital work orders
  - Payments of capital work balances
  - Late payment penalties
  - Meter pre-payment receipts
  - Sales of stock to employees
  - Sales of assets
  - Meter test fees
  - Deposits for staff (fund transfer to distant offices on behalf of staff)
  - Interest charges on late payments
  - Discounts for early payment
  - Inspection and re-inspection fees
  - Surtaxes
- Consumer and Tariff Files Maintenance:
  - On-line consumer file update
  - On-line tariff file update (tariff changes apply to the following billing cycle – that is, no split in rates during a billing cycle)
  - Changes to meter-reading records
  - Deletion of obsolete records
  - File backup and recovery procedures
- General Characteristics:
  - All system access must be password protected
  - There must be access control at the individual user level
  - File updates must have a balance trail
  - System must be hardware independent
  - System must allow for use of pre-payment meters
  - System must allow for use of meter-reading using hand-held device
  - System must allow for on-the-spot bill printing

- Customization Requirements:
  - Software customization must be performed by the bidder in the ESCOM office in Blantyre
  - Computers and workstations must be delivered prior to the complete system installation for use in the software customization effort
  - Data conversion from the existing system (Cobol in ASCII format on QIC tape format)
  - Custom reports that replicate the old reports
- Training:
  - Seminar for 10 managers describing general characteristics and features of system
  - Seminars for 11 operational IT staff describing technical details of the system
  - Seminars for 19 staff in accounting, finance, and balances using the system
  - Seminars for 42 system end-users describing the operation of each module
  - Alternatively, a train-the-trainer program could be established in which 3 ESCOM staff would be the principal trainers
- Hardware Requirements:
  - Two mirrored servers in the Blantyre office
  - Two servers – one each in Lilongwe and Mzuzu
  - 52 workstations – 32 installed in 3 networks and 20 standalone PCs for remote offices
  - 20 modems for connections to the remote offices

Lessons Learned:

- Each country's culture will drive operational procedures. In Malawi, for instance, even though the stated intent was to implement a state-of-the-art system using best practices for billing and collection, the IT and operational accounting/financing staff were continually reluctant to change procedures and adopt new approaches and reports. Even now, after using the system for four years, the technical staff encounters very serious problems because it refuses to follow best practices and run daily cash balances and correct billing errors quickly. The result is that a balance in 2003 found many problems, most of which could not be fixed (daily records going back several years would have had to be reentered and mistakes remedied). There have been critical data losses because basic system backup procedures are not followed faithfully.
- The technical requirements for each system will differ due to national laws and regulations, and because of the cultural desire to resist change.
- During installation, it is critical to have technical experts intimately familiar with the software application on-site for a period of six to 12 months. In Malawi, an applications engineer from a consulting firm in South Africa was stationed in Blantyre for eight months after the system came into operation.
- The overall system plan must include a maintenance and support contract to ensure the availability of continuous support. Most problems can be resolved via telephone and remote communications, but on-site visits should remain a potential option. In Malawi, a senior consultant from South Africa conducts an annual "health checkup," and is on-site for at least one week to help correct operational problems, and to provide training–both on new subject matter as well as re-training on basic system functions and procedures.

- While hardware maintenance should be included in the support plan, it is of secondary importance. The application software support is most critical.
- Historic bureaucratic and cultural norms have a significant impact on the implementation of CIS systems, which is further complicated in countries with weak traditions of accountability. Therefore, technology implementation must take this into account since local staff ultimately must accept and adopt the new procedures.
- Never underestimate the lack of electronic communications infrastructures in some of the countries in which USAID works. For example, the possibility of performing troubleshooting via telephone links between Malawi and South Africa has not been possible. Remote login tools simply will not work over the very poor quality telephone lines in Malawi.
- Upper level management must be totally committed to the project if it is have a chance at success. Although ESCOM management was basically in favor of the new system, it did not take an active interest in the system progress, but rather left the details to the technical staff. More continuous involvement by management could have accelerated the implementation process and could have led to more changes in the business process.

Georgia (AES Telasi, Rustavi, Gori)

Investment Information:
Georgia, just like the rest of the former Soviet Union prior to the breakup in 1991, had an electricity system funded by the state government. Electricity was perceived to be a right of the citizen, that is, essentially free. Near the time of the Soviet Union's collapse, the electricity system received little attention and all aspects of the system (generation, distribution, and transmission) began to degrade significantly. The Georgian government, with the assistance of international donors, undertook a restructuring and privatization program. In 1998 the Georgian government announced a tender to privatize the Telasi Energy Distribution Company in the capital city of Tbilisi. The distribution company served about 380,000 residential and 20,000 industrial/commercial customers.

The international energy company, AES, Inc., headquartered in the USA and operating as AES Silk Road Holdings B.V, won the bid. AES paid $25.5 million for a 75% share of Telasi. Under terms of the tender, AES was obligated to invest $84 million in improvements and to pay down $10 million in existing Telasi debt. AES Telasi secured additional loan funding of $60 million from the EBRD and IFC (in equal amounts). During the several years of operation USAID also contributed $15 million to AES Telasi's renovation program through its Winter Heating Assistance Program.

In an attempt to guarantee a supply of electricity, AES Telasi decided to invest in generating capacity. In addition to purchasing the distribution company, AES Telasi purchased units 9 and 10 of the Gardabani Tbilsresi natural gas power plant (300MW each unit), and the Khrami I (113MW) and Khrami II (110MW) hydropower pants. In addition to the $11 million paid for the generating systems, AES Telasi was obligated to pay back $80 million in WB, KfW, and EBRD loans, and it invested at least an additional $20 million in refurbishment.

In total, over the 3.5 years that AES Telasi was in Georgia, the company invested approximately $200 million dollars of its own funds in the electricity sector. In December 2003 AES Telasi sold its 75% stake in the distribution company and the generating facilities to the Russian giant RAO UES.

Operating Information:
The distribution company in Tbilisi was in terrible condition when AES Telasi took over. Residential collections were less than 10%, meters were either broken or non-existent, and corruption was rampant. Telasi did not have a modern accounting or billing system.

AES Telasi undertook extensive changes in both management and operational aspects of the distribution company. AES Telasi's main objective was to turn the distribution company into a viable entity, that is, to collect sufficient revenues to pay for power purchases and physical upgrades to the technical infrastructure. The major strategy was to re-meter every customer to allow the implementation of a billing system and provide the basis for a disconnection policy.

Here are some of the major actions that were taken by AES Telasi, and corresponding results or outcomes.

- Re-metering:
  - Over 300,000 meters were purchased from Schlumberger and installed in residential units. This covered only 80% of the populace, and turned out to be a major shortcoming of the program.
  - Commercial customers were re-metered.
- Personnel:
  - Over six hundred staff members were eliminated or replaced during the first year of operation. About 50 well-qualified manager-type people were hired and trained. Average salaries were raised by a factor of three. Even so, the company still faced a significant lack of skills to run the company adequately.
- Billing and Accounting:
  - A basic billing system was implemented during the first year.
  - A UK software development firm developed a significantly enhanced billing system, which AES Telasi installed in 2001. The system used high quality (and expensive) computer servers and workstations, RAID-based SCSI storage systems, high volume laser printers, and state-of-the-art communication and firewall systems. An Oracle 9i relational database management system was the foundation for the billing system.
  - By mid 2000, an international level accounting system was installed to handle Georgian accounting and tax code requirements, as well as International Accounting Standards.
  - A modern management information system was implemented in 2002.
- Electrical Network Reliability and Safety:
  - When AES Telasi took control, the distribution network was a patchwork of illegal connections. This situation created a hazardous work environment for the AES Telasi crew; it caused numerous fatalities for the company staff and customers. AES Telasi significantly reduced the incidence of fatal accidents.
  - Reliability was improved, and the time to repair faults was reduced to less than 24 hours.
- Power Supply:
  - AES Telasi made payments to the Georgia Wholesale Energy Market (GWEM) in an attempt to guarantee power for its customers. At times the company only received 35-40% of the power for which it had paid. The transmission system in Georgia was poorly

designed and operated, leaving opportunities for significant diversions of power to other customers.

- The lack of a guaranteed power supply from the market forced AES Telasi to purchase the thermal and hydropower generating facilities, another drain on its resources.
- By 2002, the overall reliability of the distribution system had improved substantially, but remained below targeted goals.

- Overall Performance Indicators:
  - The technical and management improvements allowed the collections rate to increase from less than 10% to over 60%.
  - By the end of AES' tenure in Georgia, the company was nearly breaking even on cash flow. However, it ended up losing 90% of its investment by the time that it sold its interests to RAO UES.

Lessons Learned and Recommendations:

- The Georgian government's performance was completely dysfunctional. Some of the major problems were non-payment by government entities, rescheduling tax collections, and repayment of tax arrears, the government's insistence on VAT payments based on total sales instead of payment collections, and interference in re-metering efforts.
- Credit should not be extended to the new government in Georgia until it institutes some major reforms. That is, the government must follow-through with promises, and provide reassurance that it will meet agreed upon performance standards.
- Actual collections are more important than the tariff.
- Bilateral contract markets work best when payment rates are low.
- Investments in distribution infrastructure and in loss reduction policies usually reduces demand thereby removing the perceived generation deficit.
- A major conundrum in emerging markets is that high levels of private sector investment results in high tariffs, which people often cannot or will not tolerate.

Georgia (USAID Demonstration Projects and UDC Management):

Demonstration Project in Rustavi:
Several years ago USAID/Georgia supported a demonstration project designed to show that, given reliable electricity supplies, the populace would pay for the services. They started with a demonstration project targeting 11,000 customers in the city of Rustavi.

Technology and Process:
A basic billing and collection system was developed for use in Rustavi. The system was a DOS-based application using the FoxPro database and development system. It was designed to track basic customer information and monitor meter readings, print bills, and keep track of customer payments and receipts.

The demonstration project included an important re-metering effort. The city is a classic Soviet-style manufacturing town with many block housing units. Existing meters in the units were repaired and/or recalibrated, and in some instances, replaced. Meters were secured in central locations within the buildings in an attempt to reduce illegal connections and meter tampering. Another critical element involved negotiating a power supply agreement with the state energy company SakEnergo. This action assured a reasonably reliable electricity supply for the pilot region.

The demonstration project was quite successful during the performance period, partially because of the technical actions taken, but more importantly because the USAID contractor staff (in this case PA) were responsible for managing the billing and collection process. Within three months the collections rate increased from 20% to 90%,and remained at a high level throughout the 4-year demonstration period.

After the Demonstration:
However, within one month after the end of USAID's support in Rustavi, the collections rate fell off precipitously. After a short period of time, the distribution company management in Rustavi decided to develop a replacement billing system. Among the reasons given were that the software technology was old, and the utility did not have the expertise to modify and maintain the application software program. A later review of the "replacement" billing system actually showed that older more primitive DOS-based tools were used in the development. More significantly, much of the data that had been included in the USAID sponsored program was no longer present in the replacement database structure. There were no indications of security measures, and the data could be modified at will.

Lessons Learned:

- It was clearly demonstrated that, given the right technical and management tools, and given a reliable electricity supply, the collections rate could be quite high for a distribution company operating in Georgia.
- Metering and billing programs are both important.
- The utility management staff are critical. Without a staff dedicated to proper management, even a good technical infrastructure will not guarantee collections.
- There must be buy-in at the highest government levels in a state-owned utility to ensure that line management has the authority and the incentive to run an efficient operation in a non-corrupt manner.

Demonstration Project in Gori:
Another USAID-sponsored demonstration program several years later built upon the work that had been started in Armenia. Because the distribution system in Georgia is similar to that in neighboring Armenia, and because of limited funding availability and the short timeframe for the demonstration project, it was decided that the ABACUS program would serve as the foundation for a billing system in Gori. The database system design and the programming techniques that had been employed, however, were not appropriate, so modifications were made to the program. The database was changed from Sybase to Microsoft Access, the program was restructured to allow networked operations, and the data was indexed to improve the performance significantly. The user interface is multi-lingual with options for Georgian, Russian Cyrillic, and English.

The metering, billing and collection (MB&C) program has been operational in Gori for over year and a half and has been performing quite well. The Gori City branch management has been supportive and the technical IT staff has been operating system with very little assistance. This is an example where the people make the difference.

Georgia Energy Security Initiative:
The Government of Georgia (GoG) would like to privatize the United Distribution Company which provides service to over 600,000 customers outside of Tbilisi. Several autonomous regions as well as the eastern portion of Georgia are also excluded from the UDC service area. The intention of the GoG and the donor community was to bring in an internationally experienced utility management company to operate the company until a buyer could be found. However, even before they could bring in a utility management firm, they recognized that an interim management contract would allow preliminary steps to be taken toward modernizing the infrastructure and the corporate management system.

Consequently, as USAID developed a new program to address multiple aspects of energy security in Georgia, it decided to include a UDC management component. In 2003 a new 4-year program, the Georgia Energy Security Initiative (GESI), was awarded to PA consulting Group. There were five main tasks: managing the national distribution company covering much of Georgia outside Tbilisi (the capital); hydropower rehabilitation; continuing a winter heating assistance program; and a community development task, with an associated credit facility component.

The UDC management component is limited to an eighteen-month period. The objective during this period was to prepare the company for takeover by an international utility management company. Areas to be addressed during the task period included restructuring the corporate organization, human resource management, technical improvements of distribution lines and substations (where possible given budget constraints), metering of feeders and major commercial/industrial/governmental accounts, customer account management, minimal residential metering (given a lack of adequate funds for wide scale implementation), business process change, and a functional, but spartan management information system.

Restructuring of UDC:
The UDC consisted of 59 branch offices scattered throughout the country with a Tbilisi headquarters facility located in the Ministry of Energy building. It was instantaneously obvious that the incumbent UDC management staff was more interested in personal gain than in operating an efficient distribution company, and that the influence of the Ministry located in the same building was unacceptable.

The first step in the process was to take over the management of the headquarters operation and install a team of ex-patriots. We followed by evaluating the staff, and identifying their job responsibilities. A large portion of the staff was either eliminated or replaced, not an easy process in Georgia, where it is illegal to fire employees. All of the employees had contracts, some term and some unlimited in duration. Buy-out plans were offered to some, and contracts were not renewed for others. The present headquarters staff is less than 100, roughly half the original number of staff. However, the total payroll cost for the HQ staff remains essentially the same. The loyalties of many of the staff are still in question, and the human resource issue remains a critical one. This is not unexpected considering that the local populace has no assurance that the old utility management will not return to power some day, and they are reluctant to burn their bridges.

Next, we decided to move the headquarters operations to another part of town. A building was selected and extensive modifications were made to install a modern computer network and provide air-conditioning and adequate heating systems. The HQ building houses the local staff as well as approximately twenty PA consultants.

A networked accounting and financial management system was installed at HQ. This package is a native Georgian product; it handles Georgian tax law issues, and is IAS compliant. A uniform chart of accounts (COA) was developed based on IAS principles. Replicas of the accounting system and COA will be implemented in the 10 regional centers and in some of the other larger branches.

It was decided that implementing CISs in the branches would be more appropriate than implementing a single large system in Tbilisi. This decision was based on best practices and on the difficulty of implementing reliable electronic communications systems for timely data transfer.

Summary data from the billing program would be entered into the accounting system in each branch location, and then the accounting information would be consolidated at HQ.

Customer Information System:
A commercial billing and collection system was not an option given the project funding and timeframe. Another factor in the decision to avoid a major investment in the financial management and CIS systems is that when an international utility management company is selected, it will most likely have its own preferred system. The main objective was to implement a basic system to provide fundamental billing services and an organized data system that could be imported into a more robust commercial system.

Because of the favorable experience that PA had with its demonstration project in Rustavi, it was decided that Rustavi would be the pilot for not only a new billing and accounting system, but also for fundamental management changes in the branches. The first, and most critical, step was to hire an elite four-person Georgian management team. This team took over control of the branch, evaluated the staff, and eliminated a large portion of redundant and incapable people. They also raised the salaries of key staff members, made major changes in the operational procedures, upgraded the physical office conditions (moved the utility office out of a city owned facility to reduce the political influence), and installed a new financial management and billing system. The hardware and software components are being primarily funded with USAID money.

The UDC management team decided to implement the metering, billing and collection (MB&C) program that had been installed in Gori. The first challenge was to port the data from the existing locally developed program to the MC&C program. The local programmer, being an independent consultant, had other jobs and was very difficult to contact. Also, his data structure was highly unusual, and it took a significant amount of time to export the data from his program to MB&C.

After MC&C was installed, the UDC management team met significant resistance to change from the operators. They understood the existing program and some refused to adapt to a different program and a modified procedure. Other motives may also have been at play.

Because of billing system database limitations, four separate databases were established, each hosting about 10,000 customers. The billing system database was installed in a production

server on the network. Four workstations were installed to service data entry for each of four regions in the city.

Intermediate Result of the Pilot Project:

- To date there has been significant improvement in the financial performance of the Rustavi branch. Multiple actions have caused this performance gain, the major ones listed in the "lessons learned" section below.
- The Rustavi pilot project is serving as an example for billing system implementation in other branches.

Lessons Learned:

- In an environment prone to corruption, the top management in the distribution company must be changed.
- Personnel issues are critical and must be addressed as soon as possible. Appropriate staff members must be in place, with adequate salaries paid in a timely fashion.
- At the branch level, installing a good local management team with authority over its own improvement program is important.
- A financial management and accounting system is absolutely necessary.
- A functional billing and collection system must be implemented to process the bills, monitor cash collection, and control aged debt and non-payment.
- An ability to identify non-payers (from the billing system) and a workable process to perform disconnections and reconnections is the "stick" required encourage higher collection rates.

Next Steps in the Billing Process:
As mentioned above, the billing system that is currently being used in the UDC in Georgia is not a robust or fully functional system. As an initial step, this MB&C program provides a starting point. However, it cannot service large customer bases, and it lacks the ability to handle sub-customers.

An upgraded billing and collection system is presently under consideration. A draft functional specification has been developed to address all of the peculiarities and special conditions of the Georgian environment. The goal will be to develop a system based on modern software development languages and tools that can be used with both large and small customer bases, and that will require minimal IT support. One of the biggest implementation problems with complex computerized applications in countries such as Georgia is the lack of local computer skills. Any system, to meet the ultimate test of sustainability, will have to operate essentially unattended from an administrative viewpoint.

Because the distribution system in Georgia is similar to that in neighboring Armenia, and because of limited time and funding for the demonstration project, it was decided that the ABACUS program that had been developed under USAID funding in Armenia would serve as the foundation for a billing system.

The database system design and the programming techniques that had been employed, however, were not appropriate for Relasi, so modifications were made to the program. The

database was changed from Sybase to Microsoft SQL Server, the program was restructured to allow networked operations, and the data was indexed to improve the performance significantly.

VIII. Cash Collection Efficiency

Collections are a primary issue of importance to distribution companies. From a business point of view, the distribution company is billing retail customers for the costs it directly incurs (for distribution and retail supply), plus the costs it "passes through" from other licensees for generation and transmission services. The significant point is that generation costs may represent as much as 60% of the costs billed to the retail customers, and transmission service can represent 10%. Distribution companies therefore operate on a thin margin. When customers do not pay, the distribution company is unable to recover its costs (30% of the bill) and lacks cash to pay suppliers. In many developing countries, the distribution companies often have large unpaid debts to the generators, resulting in the vicious cycle of debt, as it has come to be called.

Developing countries have cash collection problems for a variety of reasons. In those countries recently evolving from planned economies, utility managers traditionally had very limited control over collections, which were often determined by economic planners outside the sector. When "Collections" were realized, they may have been in the form of offset or barter. Tremendous pressures are placed on electricity providers to continue supplying state-owned industries (which often are bankrupt) with electricity in order to keep factories running, which in turn provide jobs for the local population. State and local politicians were accustomed to having significant influence over electricity suppliers, and resist the erosion of that influence. Another important factor is that the management and employees of state owned utilities were not required to consider customer issues such as service levels, communications, satisfaction, etc.

As part of the overall restructuring process, it is extremely important to conduct capacity building in basic business management concepts for all sector participants. As far as collections are concerned, the distribution and supply entities are the primary interface with customers; therefore, they are the key to improving the situation. Utility management has historically focused on technical operations of the facilities. In the newly restructured environments, this technical focus must be maintained (and strengthened where possible), but the management team's primary challenge with newly created companies is to develop a business management focus. One of the objectives of commercialization is to facilitate the transition of a government entity into an independent business. It is often helpful for large business managers to focus on the basics and keep in mind the things that all good small business owners do on a daily basis. In fact, many of the modern business management theories focus on making large organizations (that often become bureaucratic over time) think and act like small businesses. Many of the theories also focus heavily on the importance of providing high levels of customer service and delivering value for the price. Basic business management principles may be phrased in many ways, but for distribution and supply companies they should include the following:

- Deliver electricity efficiently (minimize losses and provide quality service)
- Measure what you receive
- Measure what you deliver
- Bill customers accurately for their electricity consumption
- Aggressively manage accounts receivable and collect revenue
- Provide customer service and value for the price

- Effectively track and manage costs

To enforce collections, distribution companies, in addition to applying solid management principles, must have the proper tools at their disposal. An effective Customer Information System as discussed in Chapter VII is required to effectively manage Accounts Receivable. In many developing countries, experience has shown that the only proven way to enforce collections is to be able to effectively use the "tool" of disconnection (including the threat of disconnection).

Distribution companies do not operate in a vacuum. They are impacted by national issues of law, politics, and a variety of social issues. Industry regulatory issues also affect each company.

This chapter will focus most heavily upon management issues – the application of solid business principles and best practices that can be utilized to effectively manage Accounts Receivable and thereby improve cash collections. Management teams can achieve results here if properly focused and given incentives to improve. In order to be able to apply commercial principles, however, the national environment, including legal, political, and social foundations must be in place. Regulatory mechanisms affecting the entire industry also must be conducive to a commercial environment in which companies can deal effectively with their customers. We identify best practices for the national and regulatory environments as well as for the company management teams.

The National Environment

Overall Legal Framework
Some developing countries have well-established legal foundations, benefiting distribution companies in various ways, such as through commercial law principles and access to court systems. Other countries have weak legal systems, particularly with respect to commercial aspects.

When a viable commercial legal environment does not exist in a given country, utility collection efforts can be very difficult. Local custom and tradition often get in the way of instilling a payment discipline among all customer classes, especially households. Historically, electricity was often perceived as a right; utilities provided service at a nominal price and did not enforce collections. Certain customer groups often received "privileges", entitling them to free or highly discounted service. When these privileges are rescinded, customers blame the government and they resist reforms. State and local politicians see some of their power base eroding when they cannot grant these privileges. In order to achieve cash collection percentages expected of a commercial business, the legal framework must be in place, politicians and government officials must not interfere, and distribution companies must have a business orientation.

Energy Law Provisions
Energy laws typically focus most heavily on institutional issues such as market structure, establishing an independent regulator, antimonopoly issues, licensing requirements, the authority and responsibility of sector participants, etc. Reform programs should ensure that energy laws incorporate provisions that make the job of sector participants easier.

One such provision should be to make electricity theft illegal. If it is not defined as illegal in other legislation, the energy law should close the gap. For example, during Ukraine's Socialist

period, electricity was defined as a "service." Legislation made it illegal to steal a "product", but not a service. Therefore, theft of electricity was not considered a crime, and the legislation had to be changed to define electricity as a product.

The energy law should also clearly authorize the utility to disconnect in cases of non-payment. All customer classes should be subject to this provision. Of course, the rules of service, or "contracts," with the various customer classes must specify the reasons for which customers may be disconnected, notification requirements, etc., in order that such occurrences be made in a businesslike manner – not command and control.

Also, it is important that the distribution entity have access to legal expertise in order to protect its interests and take advantage of all legal avenues available to collect its Accounts Receivable. The legal expertise could be in-house or available from outside firms.

Other Laws and Legal Issues

Civil and criminal laws must not contradict the energy law. Distribution companies should not be liable for damages caused by disconnecting customers for non payment (assuming that the utility follows the rules for disconnection, including reasonable notice). An experience from Mongolia illustrates the point.

Eastern Energy System (EES), one of the new companies created as a result of the energy restructuring initiative in Mongolia, decided to take a more aggressive approach to customers who were stealing electricity by "hooking", or illegally tapping into the distribution circuit. Although the Law of Mongolia on Energy was clear in defining electricity theft as illegal, and gave the distribution companies the specific right to remove illegal connections and fine customers, the local court applied other laws to the situation. One household repeatedly made illegal connections, and EES would remove the conductor used to tap into the circuit. The customer sued EES for the value of the conductor, arguing to the court that his property was stolen. Unfortunately, the local court agreed with the customer and ordered the utility to pay restitution. The case is being appealed by EES.

Similar to this situation, local politicians and large industrial concerns often turn to courts to prevent disconnection or to "punish" distribution companies exercising their right to disconnect large entities for non-payment. Due to political pressure (or in some cases corruption), judges often assess fines and damages.

Legal Impediments to Writing off Accounts

Mongolian Law requires a creditor to go to court prior to writing a bad debt off from its books. This is required even though it is obvious that the debtor is (1) not collectible (bankrupt, in jail, etc.); (2) not able to be located (moved away and cannot be found); or (3) dead. Other countries have similar laws, especially those in the former Soviet Union.

Of course, there are court costs involved (a revenue source for the judicial system), which probably explains the reason for the process. Distribution companies are, therefore, reluctant to go through the process of writing off the accounts, resulting in an overstatement of accounts

Tax and Accounting Issues

In most developing countries, there is a considerable amount of confusion, misunderstanding, and conflict in rules of various governmental and regulatory bodies on the issue of writing off "bad debts". Many tax systems do not allow creditors to have an allowance for bad debt. When revenue is recorded, it is generally taxable. Later, when a write-off is made, there may be no effect on taxable income; therefore, the incentive that exists in most developed countries—a tax deduction and therefore a reduction in tax expense and an increase in cash flow—is not

available in other countries. In many of the former socialist countries, a bad debt cannot be written off until the creditor pursues collection through the court system.

Budget Organization Issues

Budget organizations include national and local governmental agencies funded by public sources. They provide various essential services such as military, police, fire, hospitals, and water supply, as well as administrative, educational, and other services. In many developing countries (especially those emerging from centrally planned economies), paying an electric bill was not a concern for budget organizations. State and local politicians often feel that they can use their political power to keep the supply of electricity flowing when they run short of funds. Separating "essential" service organizations (police, fire, water) from other organizations is critical for the distribution company, since they should be able to exert more pressure on the non-critical organizations. Prior payment patterns will also indicate those organizations that generally pay late (but eventually pay) and those that continually increase their debt to the utility. The distribution company should approach those situations differently.

Distribution companies should work with budget organizations to help them determine the funding amount they should request annually in order to meet their electricity needs. If the allocation from the central budget for electricity payments is not adequate, the budget organization will not have the funds available. Ensuring that the organization's budget allocation for electricity is not diverted to other uses is also important. In Ukraine, for example, the electricity companies attempted to discontinue electric service once the budget customers reached the consumption amount allowed per their budget allocations. Unfortunately, there was insufficient political will to follow through with the disconnections.

The distribution companies can attempt to gain political support by communicating the situation of budget organizations to the public. The public must realize that their electricity tariffs will have to be increased if budget organizations do not pay or pay very late.

Dealing with Large State Owned Entities

The primary area of concern in most developing countries is that of collecting from state-owned entities in heavy industry. These entities often provide the majority of jobs and other benefits to a community; however in many cases they are not able to produce positive net income or cash flow. Interference from local and national politicians as well as government ministries is to be expected here.

Residential Customer Issues

In developing countries, it is important to change perceptions regarding electricity—people need to acknowledge electricity as a service provided by a commercial enterprise rather than a service provided by government. Households have traditionally received electricity at highly subsidized tariffs and exert considerable political pressure to keep tariffs low. Increases in tariffs are also used to justify electricity theft, or to pay late or not at all. Given popular sentiments and social pressures, politicians are often reluctant to allow distribution companies to take collection action, up to and including disconnection.

Developing countries often have a high percentage of households living below the poverty line. Many people do not pay for electricity because they do not have the financial resources. Distribution companies, in conjunction with the regulator and government agencies, must find ways to address this situation. In some developing countries, donors have funded "affordability studies" to determine how much various customer groups can afford to pay for electricity. This is helpful when designing low-income tariffs and determining the amount of subsidy to give a

customer class. It is also helpful for politicians, government officials, the press, and the public in general to be knowledgeable about this information.

Public Education as a Tool for Improvement of Collections
Residential customers tend to be the most vocal about issues such as poor service (rotating blackouts, brownouts, and other service interruptions) and tariff increases. These customers often perceive the utility to be poorly run, inefficient, and in many cases corrupt. It is therefore extremely important to improve customer services and provide value for the price. In those cases where newly restructured utilities work hard to achieve efficiencies, they should communicate that fact to customers and provide the straight story about cost levels and tariffs. Of course, where the price is set significantly below the cost to provide service, this is a challenge. Customer communications then comes into play as a way to get the message out in a clear, rational manner.

It is important to educate the public in order to change perceptions of electricity as it transitions from a government service to a commercial service. Customers must recognize the importance of paying for electricity, and also receive value and quality service by so doing. This will help build public confidence in the commercial entity, and help to erode political interference and corruption. Public education and outreach efforts should focus not only on the problems of theft and non-payment, but also on the concrete steps that the utility is taking to improve service, such as making electricity more reliable, expanding service coverage, etc. Education could include messages such as:

- Stealing electricity is not a victimless crime. Your neighbors must pay more to cover the loss of energy
- Non-payment of bills also puts a cost burden on your neighbors
- When state-owned factories do not pay, the commercial and residential sectors effectively subsidizing them
- Efforts underway to reduce costs
- Efforts underway to improve service levels (quality and quantity)
- Tariffs compared to the cost of providing service by customer class

Utilities need to get such messages across to politicians, government officials, and the press, in addition to the general public. Politicians and special interest groups often exert considerable political pressure to prevent distribution companies from taking effective collection action. In a more commercial environment, this must stop.

Regulatory Issues

The regulator can provide the foundation giving the distribution company the opportunity to collect from customers. Rules for service should incorporate reasonable policies for dealing with slow paying customers such as:

- *Customer Deposits*: From the distribution company's point of view, the ideal situation is to have a deposit from the customer so that if and when the customer fails to pay, the company can satisfy the debt with the deposit. Of course, the rules for service could require deposits from all classes of customers, some classes of customers, only for new customers, or for customers that have poor credit or a history of payment problems. In order to protect the customer, the regulator should ensure that the funds are properly accounted for and that the customer receives compensation for the opportunity cost of the funds (interest on the

amount outstanding). Customer deposit issues will be discussed more thoroughly in the next section.

- *Prepayment*: A prepayment is similar to a customer deposit in that funds must be on deposit with the utility prior to service being rendered. For some customers, prepaid meters are the only way for the utility to ensure payment. Although prepaid meters are significantly more costly than standard kWh meters, they may offer an option to provide service to customers that have a difficult time managing their limited budget.
- *Interest on overdue amounts – late payment penalties*: Once a customer has been given a reasonable time in which to pay the current bill (up to 30 days is common, although it can be less) the utility should charge interest. The interest could be a fixed percentage of the bill (1 to 10%), a daily interest rate applied to the unpaid balance, or another option. See the next section for a discussion of interest on overdue amounts.
- *Ability to disconnect*: As discussed throughout this report, the most effective tool to enforce payment discipline is to allow the distribution company to disconnect customers. Rules for service should clearly spell out the right of the company to disconnect for non-payment (and other reasons as well, including theft, safety issues, etc.). As discussed above, the Law of Mongolia on Energy was very clear in allowing disconnection for non-payment. The rules for service also clearly spelled out the right of the distribution company. However, there are other barriers to the use of this tool. Without the clear signal from the regulator, however, the distribution company does not have a chance.
- *Requirements for disconnection notification*: Distribution companies want to continue selling electricity to customers and generally resort to disconnection only as a final measure. The rules for service (or some other regulatory directive) should clearly spell out the notification period required for disconnection considering the right of the customer to be able to rectify the situation in a reasonable period of time and prepare for the loss of power if inevitable (especially in the case of industrial processing firms). The regulator must balance this against the right of the distribution company to discontinue supplying "free" power to a customer. The regulator should prohibit the practice of some utilities where they disconnect an entire distribution circuit because one or more

Practical Disconnection Issues

The Darkhan Selenge Electricity Distribution Network in Mongolia was repeatedly told by the Ministry of Infrastructure, the Aimag (State) Governor, and the Energy Regulatory Authority that it could not disconnect a state-owned cement company (its largest customer) for several reasons. One reason was that the cement company received power from the same circuit as another entity operating a facility providing heat to local businesses and households; the circuit could not be shut down since because of the need for heat in the cold climate.

The distribution company decided to defuse this traditional argument by offering to provide enough energy to the circuit to operate the heating station but no more. This allowed them to accomplish the objective of discontinuing supply to the cement company; however, for other political and social reasons the cement company power was restored within a matter of days.

Similar situations exist in other countries, especially those of the former Soviet Union. The issue of "micronets" (small communities receiving electrical service from the substation within the industrial complex) is one example. Distribution companies have had continual problems disconnecting the non-paying industrial customer since it would involve also disconnecting hospitals, schools, water supply, and other community services.

Distribution companies may be wise to reconfigure their distribution facilities or install adequate switching so they can disconnect non-paying customers without affecting other customers. The investments may prove to offer a large payback.

customers did not pay their bill. This is not fair to those paying on a timely basis and, in the new environment, customer relations are important.

Every business that grants credit can expect to experience some amount of bad debts. The electricity industry provides customers with a significant amount of service prior to receiving payment. Customers are generally allowed to consume energy for a one-month period before receiving an invoice, and then the customer usually has 15 to 30 days to pay. On average, this provides customers 30 to 45 days of credit, assuming they pay according to terms

In addition to providing distribution companies with the tools to enforce collections, regulators should also provide whatever incentives they can. If distribution companies were fully commercial enterprises with profit incentives and operating in accordance with commercial laws, no additional incentive would be required. However, many distribution companies in developing countries do not operate in a commercial environment. The challenge lies in how to provide effective incentives to distribution companies, many of which are state-owned and lack a strong profit motive. As discussed below, although the entity as a whole may not respond to financial incentives, employees generally do. An employee incentive plan focusing on Key Performance Measures related to metering, billing, and collection issues may be the answer. Regulators should encourage such incentive compensation (pay for performance) plans.

Despite the best efforts of the distribution company management and employees, some amount of accounts receivable will never be collected. The regulator must recognize this and include an allowance for bad debt expense in tariffs. Many developing countries (Mongolia, Bangladesh, and Indonesia, among others) resist including bad debt expense in tariffs. This, of course, results in the distribution company having to absorb this as a loss, further eroding the financial position of the entity. The level of bad debt expense, generally based on a “normalized” percentage of billed revenue considering the distribution entity is aggressively managing accounts receivable, should be included in the revenue requirement of the entity and provided for in tariffs, similar to any other cost of doing business.

Importance of a Business Management Focus for Distribution Companies

In developing countries, the management focus of a bundled state-owned electric utility has primarily been on the system’s technical and operational aspects. Management teams severely lack business management skills, and this is why capacity building on these skill sets is so important in any restructuring situation. Of course, customer relations is one critical business management skill. In many cases, when state-owned entities were restructured along functional lines (generation, transmission, and distribution) the personnel did not have the skills needed in their new role. Furthermore, generation was often considered the most important function and a more prestigious area to work. The most qualified people were, therefore, assigned to the generation side of the business. In a more commercial environment, the distribution side of the business is critically important since the companies have direct contact with customers and are the conduit for the product/service on the operations side, and the cash flow on the financial side.

The management teams of distribution companies, therefore, must acquire business management skills in general, and approach the collections process by managing accounts receivable. As discussed in Chapter VII, an efficient Customer Information System provides managers with many of the tools to be effective and efficient in their job.

Managing Accounts Receivable

Accounts receivables arise when a company grants credit to its customers. The balance of accounts receivable at any point in time represents a corporate asset that must be managed similar to other assets, such as plant equipment and inventory. In a commercial environment, the management team must balance customer relations concerns and company interests. On the one hand, utilities must give customers a reasonable time period to pay their bill, but not too much time since the utility has a cost (often referred to as the time value of money) related to carrying accounts receivable.

In order to properly manage accounts receivable, management must have the proper tools. A properly designed and implemented Customer Information System (CIS), as discussed in Chapter VII, provides valuable information and the capability to monitor and carry out accounts receivable management. Many of the management practices described in the following subsections rely on an effective CIS.

Segregating Customers

To effectively manage Accounts Receivable, the task must be segregated to effectively deal with the unique characteristics of various customer types. Logical groups would include:

- Very large customers that must be treated on an individual basis, such as the 10 to 20 largest industrial or commercial consumers
- Other industrial and commercial customers
- Budget customers
- Residential customers
- Other unique situations such as agriculture in some countries

Collection Metrics

To analyze the situation for each of these groups, it is helpful to use various measures. One such measure is Day's Sales Outstanding (DSO), which is generally defined as:

$$\textbf{DSO} = \frac{\textit{Accounts Receivable Balance}}{\textit{Sales per Day}}$$

Where Sales per Day is in monetary terms and equals annual sales divided by 360 days per year

This provides the company with a usable measure to quickly see how many days usage the customer, or customer class, has in unpaid bills. For customers with seasonal usage patterns, adjustments are often required to get a realistic picture.

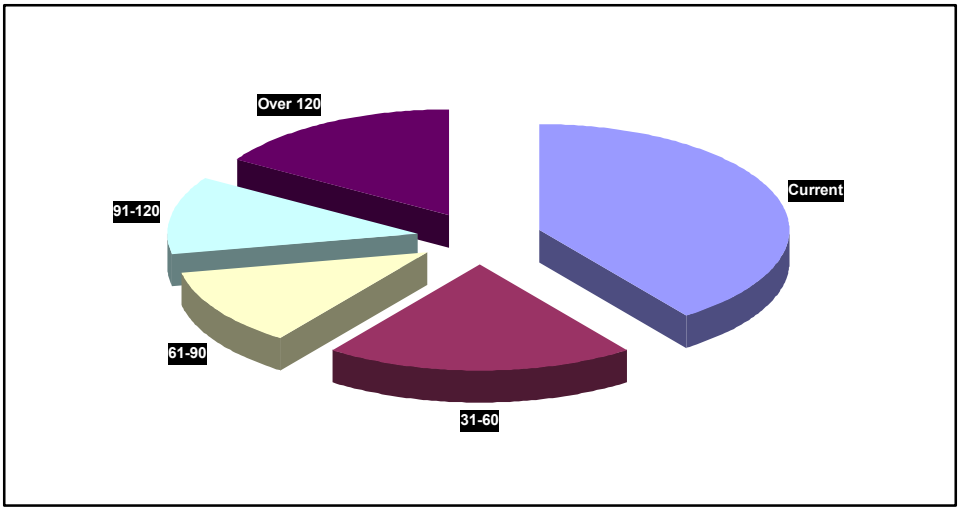
The other useful measure is an Accounts Receivable Aging Schedule. This provides useful information in addition to DSO, particularly when analyzing groups of customers. An aging schedule would look as follows for a hypothetical company with a 30-day payment period:

Table 8-1 Accounts Receivable Aging

A/R Balance	Amount	% of Total
Current (0-30 Days)	1,000	40%
31 – 60 Days	500	20%
61 – 90 Days	300	12%
91 – 120 Days	300	12%
Over 120 Days	400	16%
TOTAL	2,500	100%

It is often helpful to provide the information as presented in Figure 8-2 below.

Figure 8-2 Accounts Receivable Aging



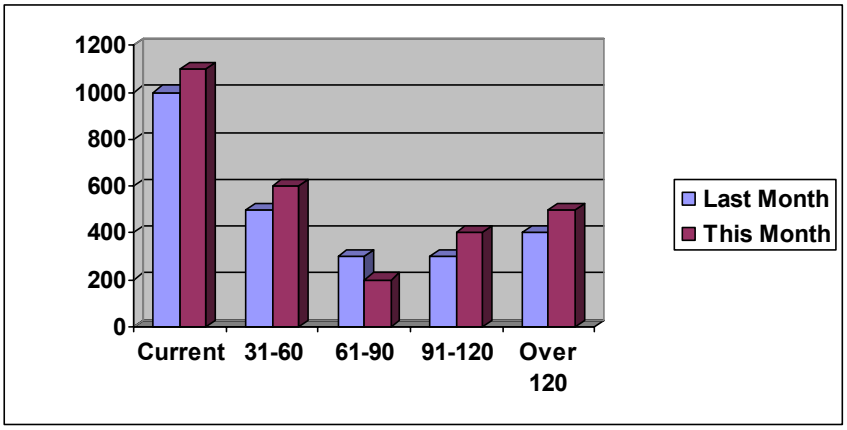
It is even more helpful to be able to analyze trends in the composition of Accounts Receivable. Table 8-2 compares the current month balances to the prior month to give the reader a feel for how the situation has changed

Table 8-2 Accounts Receivable Comparative Information

A/R Balance	Last Month	This Month
Current (0-30 Days)	1,000	1,100
31 – 60 Days	500	600
61 – 90 Days	300	200
91 – 120 Days	300	400
Over 120 Days	400	500
TOTAL	2,500	2,800

The information is displayed in bar chart format in Figure 8-3 to provide a more vivid picture of the situation.

Figure 8-3 Comparative Information on Accounts Receivable



Obviously, the Customer Information System Accounts Receivable module would have to be configured to provide such information. See Chapter VII for a discussion of Customer Information Systems.

The utility should monitor both of these measures monthly. When the management team sees deterioration in the situation (number of days sales increasing and/or increasing amounts more than 60 days overdue as a percent of the total) attention is required for that customer or customer class. The measures can be used to provide an "Early Warning" of individual customers or groups of customers that are in trouble. Displaying the information graphically is an effective way to communicate the situation. The point is to communicate information in a useful manner to measure and monitor the collection situation. The adage "What gets measured – gets done" is very appropriate in this situation.

Debt Repayment Scheduling

In order to deal with its large cash-strapped customers, Darkhan Selenge Electric Distribution Network (DSEDN) in Mongolia decided to work on a specific basis with individual customers in a new manner. This included its three largest customers, a cement company, steel company, and meat processor. Considering each customer's business situation, including their business cycle and seasonality, a DSEDN proposed a debt repayment schedule with periods up to one year, and interest at the cost of short-term bank loans. DSEDN developed and discussed the proposal with the executive directors of the state-owned entities. The document required payment for current consumption in full each month, plus the specified amount for arrears. The executive directors of the Distribution Company and the Customer organizations signed the agreements. The meat company honored its commitment, however, the steel and cement customers did not, and as a result, their service was disconnected. Unfortunately, due to pressure from the government, power was restored in a matter of days, with only minimal payment received.

Dealing with Bankrupt Customers

Bankrupt customers present a unique challenge to distribution companies. In many developing countries, large state-owned industries may not be bankrupt in a legal sense, but are technically bankrupt since their liquid assets (and possibly their total assets) may be insufficient to meet their current obligations. It is often impossible from a practical, if not a legal, standpoint to collect amounts for prior debts, although the distribution company should take all measures available to do so. Prudent business practice dictates that, although old debts may not be collectible, the creditor must not allow additional debt to accrue. This situation requires close management attention in monitoring usage and payments. In developed countries, utilities segregate "old debt" and "new business" for customers in bankruptcy. In order to prevent additional debt from accruing after

the bankruptcy filing, utilities often require payment in advance. Electricity suppliers can estimate usage for a future period, which may be as short as a week or as long as a full month, and require the customer to pay in advance. Any difference in consumption would be reconciled at the end of the period. Distribution companies must communicate to the customer, politicians, government officials, and the general public that electricity supply is no different than the supply of raw materials, labor, or transportation services.

Customer Deposits
Another tool that distribution companies can use is to require a deposit from customers. The deposit is generally determined based on the estimated usage of the customer for periods ranging from 30 to 90 days. Deposits may be required for:

- *An entire customer class:* This would be used for those customer classes that are perceived as high credit risks. Customers receiving temporary service for construction sites or special events would be examples, although the requirement could be applied to all customer classes.
- *New customers*: After a period of say, 12 months, if the customer has remained current in their payments, the deposit could be returned, with interest.
- *High credit risk customers:* Customers that have proven to be poor credit risks. These may be customers that have continually paid late or have been previously disconnected for non-payment or electricity theft.
- Customers in bankruptcy.

Of course, the regulator would have to authorize such deposits in the rules for service, specifying the requirements. As a general rule, the distribution company would pay interest on the customer deposit at a rate specified by the rules. That rate could be fixed or variable, based on other short-term rates. A common rate would be the distribution company's short-term borrowing rate.

Interest on Overdue Amounts
Regulators in developing countries are often reluctant to allow distribution companies to charge interest on overdue amounts. In some countries it may be against the law to charge interest to some or all customer classes. If customers know that paying late will increase their cost, they will pay on time, assuming they have the funds. Of course this also assumes that the customer believes that the distribution company will actually follow through on collection efforts, otherwise the customer will ignore the threat.

Interest may be assessed in various ways. For example, the company could apply a "Late Payment Charge" to the bill at a rate of 1 to 10 percent of the amount if it is paid after a certain date. This method is common for households and other small customers. For larger customers, the interest may be assessed on the unpaid balance at a fixed or floating rate per day for each day outstanding.

If there is a legal or cultural bias against charging interest, an alternative may be to allow a "Discount" for payment of the bill within a prescribed time. In some countries there is precedence for such payment terms.

Of course, in either case, the Customer Information System must be configured to give the company the ability to compute and post the interest (or prompt payment discount) to the customer account.

Dealing with New Customers

Collection improvement initiatives generally focus on existing customers. In order to address the issue effectively, however, the distribution company should seize the opportunity to eliminate future problems by screening new customers. Checking a potential new customer's credit history, to the extent possible or practical given the commercial tools available in the specific country, can help in the future management of accounts receivable. If a customer (residential or business) has outstanding amounts owing from service at the current location or service at a prior location, the customer should be required to satisfy prior debts before being eligible to receive service. If the customer has a poor credit history (assuming such information is available), then a deposit or prepayment should be required. In the case of a large business, a letter of credit from a reputable commercial bank may also be an option. If the distribution company is unable to assure payment, then service should be denied, in accordance with any business rules that may be imposed by a regulator.

Disconnection

The only way for a distribution company to truly have leverage with customers is to be able to disconnect them for non-payment. The imminent threat of disconnection is generally effective in getting customers to pay. Of course, that assumes they have the funds available to make the payment. If they do not, then the company must follow through with disconnection. Unfortunately, larger customers with political clout often count on politicians or government ministries to exert their influence to keep the power connected.

The "Value" of Disconnection

An example of the value of disconnection to a distribution company can be illustrated by comparing the experiences of heat distribution companies to electricity distribution companies in Mongolia.

Given the extremely harsh winters in Mongolia, the heat supply is not disconnected for non-payment during the heating season. At the end of the heating season, the system is shut down until the beginning of the next season. There are a significant number of customers (households, businesses, budget entities) that do not pay their monthly bill on time; however, they continue to make payments in the non-heating season. At the beginning of the next heating season, those customers having outstanding balances from the prior season are not reconnected to the heat system. Of course, since most customers know that this is the policy, they make every effort to get their account current during the summer. Of course, this situation allows customers to spread their heating costs over the full year. This is very similar to budget (or levelized) billing practiced in many developed countries. The result is that the heat distribution companies experience a much higher overall collection percentage than the electric companies

The point is that heat customers have become accustomed to being disconnected for non-payment and, therefore, make sure that they pay their arrearages, at least in time to avoid disconnection. The electricity distribution companies should learn from this example that properly enforced service discontinuation is the most effective way to ensure payment discipline

Incentives to Improve Collections

Management often finds it necessary to provide incentives to its employees to improve performance. Performance on collection of accounts receivable should be included in the Key Performance Measures (KPMs) used in a company's incentive compensation (pay for performance) plan. Measures such as Days' Sales Outstanding, the percent of customer accounts more than 60 days overdue, or the percent of customer accounts that are current (a more positive measure) could be used to establish targets and measure progress. This could

be applied to an entire group of employees or to specific employees based on the accounts they are responsible for, as discussed in the following example.

Such incentive plans can be helpful as a management tool. However, state-owned distribution companies generally lack a strong profit motive. Since employees generally respond positively to monetary incentives, they can be effective when trying to improve the company situation. In many developing countries, corruption is a fact of life. There may be many reasons for this, but an important one for company management to consider is that poorly compensated employees are vulnerable to corruption, and may feel the need to supplement their income to provide for their families. If employees receive the proper incentives, they can benefit financially along with the company if collections improve. The company should strive to make honesty beneficial to employees. Of course, in addition to reward, the company must communicate to employees that they will lose their jobs for dishonesty. An employee would think twice about losing a good job.

Incentive Plan for Bill Writers

Darkhan Selenge Electric Distribution Network in Mongolia developed an employee incentive program for "Bill Writers", employees responsible for meter reading, billing, and collection for household and small commercial customers. The company meters electricity delivered to each distribution circuit from the substation. Data can, therefore, be collected to compare the amount of electricity delivered to the circuit to the amount billed, and subsequently the amount collected. The bill writer incentive plan has a formula for additional compensation based on 2 measures - percentage billed and percentage collected. The plan was most heavily weighted based on the collection percentage. The Executive Director asked the advisor to review and comment on the plan. A recommendation was made to weight the billed percentage more heavily since that is the factor over which the bill writer has the most control. That recommendation was accepted.

Regulators should encourage distribution companies to implement such incentive compensation plans. The cost of the plan should be included in tariffs.

Billing Issues Affecting Collections

Accurate and informative invoices can facilitate collections. If a customer perceives a bill to be wrong, then that customer will be reluctant to pay it. The typical cause relates to meter reading. The reading may in fact be wrong, the customer may perceive it to be wrong, or an estimated reading may result in consumption that is perceived to be too high. Of course, the bill should indicate whether the consumption is based on an actual or an estimated reading. If an estimate is used, the customer should be made aware of the estimation method (prior month, same month last year, average of x months, etc.). "High Bill Complaints" generally represent a large percentage of customer complaints, either in person, on the phone, or in writing. Customer service personnel should attempt to resolve these complaints in a timely manner in order to facilitate the customer paying an accurate amount as soon as possible.

The bill should clearly show:

- The amount due for current consumption, and corresponding details—this includes consumption and tariff for each block, fuel or other adjustment mechanism charge, customer charge, demand charge, etc.
- Overdue amounts, aged if possible
- Interest or late payment penalties
- Payments received since the prior bill was rendered

- Due date
- Status of any prepayment or security deposit
- Messages such as reminder notices of overdue amounts or disconnection date.

Customers on fixed incomes often would like to pay their bill but cannot pay the entire amount due. The utility should allow and encourage partial payments, and ensure that the billing and collection systems can accommodate such payments.

The utility should also have procedures for posting payments, in accordance with any rules prescribed by the regulator. The general rule is that payments are first applied against the overdue balance, and then against the current bill. Depending on a country's tax laws, there may be regulations on how payments are applied to the Value Added Tax or other taxes included on the bill.

Accurate, informative, and timely bills make the collection effort much easier. An effective Customer Information System, as discussed in Chapter VII, is a key management tool.

Making it convenient for customers to pay
In many developing countries it is very inconvenient for a customer to pay the bill. This may be due to an inadequate number of payment locations, or limited hours for payment centers, especially if they are not open at times when working people can utilize them. Distribution companies should view cash collection as a business process to be managed. Accordingly, companies must devote resources to establish, operate, and staff payment centers in accordance with good business practice and financial considerations. The financial viability of opening additional payment centers should be considered along with customer relations and other strategic aspects.

In addition to company payment centers, customers could be given other options such as payment in person at commercial banks, automatic withdrawal from bank accounts, payment by check, or payment at other non-utility facilities such as municipal offices or retail facilities. Of course, many of these options depend on the sophistication of the banking system and the ability to rely on other entities to handle payments. When outside personnel handle payments, the utility must have a mechanism to ensure prompt posting to the customer's account.

Excerpt from 10 October 2000 Tariff Order of the Gujarat Electricity Regulatory Commission

Payment of Bills. Consumers indicated that, under the present system, there are long queues for utility bill payment. They suggested that the utility should deploy more staff to receive payments at various offices. The Commission is entirely in agreement with the suggestion that there should be proper and adequate facilities for bill payment.

The Commission would like the Board to enter into arrangement with various banks for bill payment. In the areas where such arrangements are not possible, additional staff should be deployed for receiving payment. All efforts should be made to ensure that there is no inconvenience for bill payment by the consumers. The Commission would like the Board to set up and finalize the norms in this regard, announce it to the public, and make necessary arrangements for observing the same.

The example above illustrates the importance that the regulator in the Indian State of Gujarat placed on the convenience of customer payments.

Dealing with the 20 Largest Customers
The distribution company often has the greatest collection problems with its very large customers, especially those that are state owned. Each of these customers should be treated

individually, and the distribution company should establish a rapport with each customer and get to know their business situation and cash flow pattern (especially for seasonal businesses). The distribution company should monitor sales and accounts receivable monthly, as well as maintain a regular dialog with the customer.

For those customers with significant arrears, the utility should develop a payment schedule with the customer, considering when it will have the financial resources to satisfy the arrears. Unrealistic payment schedules are useless and further undermine confidence in the process. When it is obvious that the customer's business plan does not project sufficient financial resources, the customer should be treated as bankrupt, and future electricity supply should require payment in advance (daily, weekly, or monthly).

Dealing with Other Commercial and Industrial Customers

It is often not possible for the distribution company to deal with its many other commercial and industrial customers individually; therefore, it is important to have a uniform policy toward these customers and to apply it consistently. This should be spelled out in the Business Rules, or Rules for Service. Of course, if a customer has a unique situation, there should be the flexibility to establish a specific payment schedule for arrears. To the extent that some of these customers may be in seasonal businesses, specific payment schedules are important. Interest should be applied to overdue amounts on a consistent basis.

Very often there is less political interference involved with these customers (especially compared to the other classes) and, therefore, the distribution company can treat these customers in a more commercial manner. Very often, electricity is not a high percentage of their cost structure; therefore, these customers generally have the ability to pay. Furthermore, the threat of disconnection is highly effective with these customers.

Budget Customer Issues

When dealing with budget customers, the distribution company must track the timing of customer payments. The distribution company should segregate these customers into those who pay late but eventually pay, and those who continually accumulate debt.
Distribution companies should pursue appropriate outreach strategies to explain how paying customers may have to cover the shortfall from non-paying customers. This can be done through the media and directly with politicians, since this involves a voter issue.
Offsets are a possibility for these customers as well. Offsets involve mutual cancellation of debt, and in the case of "budget" customers, often involve offsetting electricity bills with tax payments. Although reform programs generally discourage barter and offsets in the drive to have a more commercial energy environment, offsets can be a temporary means to prevent unnecessary debt accumulation.

Residential

A documented and consistently applied collection policy is very important for this class. If paying customers see their neighbors successfully avoid paying, they may decide to follow suit, resulting in a cascading problem. Also, the distribution company must uniformly enforce the disconnection policy, and ensure that when customers are disconnected for non-payment they do not reconnect themselves. This can be very obvious to neighbors. For both of these issues, public information can help emphasize the importance of paying on time in order for the company to continue in business and charge reasonable tariffs.

Special Situation Customers
Every distribution company has certain customers that present unique problems. They may be a large group of agricultural customers or a few large industrial concerns accounting for a significant percentage of GDP or exports. The situation in the State of Gujarat in India provides and example.

The Agricultural Block in Gujarat
In the Indian State of Gujarat, over 40% of electricity consumption goes for irrigation, much of it for marginal farms. Since the agriculture sector provides a significant amount of employment, however, the farmers are a formidable political force. As a result, tariffs for pumping are significantly below the cost of service (actually less than the cost of fuel for generation). In addition, the collection percentage for these customers is very low. Since disconnection is not politically possible, other ways of coping with the situation are needed. The distribution company has been coping by having rotating blackouts, and generally providing power only to rural areas during off-peak periods to minimize losses, a form of forced Demand Side Management. The newly formed Gujarat Electricity Regulatory Commission has been struggling to improve this situation and deal with the political and social issues.

Managing the Customer Relations Aspects of the Business
Several preceding sections discussed the importance of managing accounts receivable as a business process. Modern business literature places a heavy emphasis on customer orientation, mainly providing quality service and value. Utility managers in most developing countries have not been faced with the need to provide world class customer service levels and, for the most part, have never factored customer relations into the decision making process. Therefore, the first step is to build capacity in the area of customer relations as part of the overall support to restructuring and commercialization.

In general, customers expect to receive value in a commercial transaction. The provision of electric service is no different than any other transaction in that respect. We can think of customer value as being represented by the following simplified equation:

$$CustomerValue = \frac{Service}{price}$$

Customers receive value when service levels are high and price is low. In the context of developing countries, of course, both service levels and prices should be appropriate for the situation. If service levels have historically been very poor, with high frequency and duration of outages, the focus should be on continuous improvement, not overnight results. Likewise, if prices (tariffs) are significantly below the cost to provide service, the focus should be on effective cost control (efficiency) while bringing prices in line with costs. This all takes time.

The old saying “perception is reality” is appropriate in dealing with customer issues. If customers perceive the utility to be inefficient in providing service at reasonable cost, then it is incumbent upon the utility to first become more efficient, and secondly to communicate to customers the steps it is taking to make improvements, in an honest, straightforward manner. The significant culture change required to move from a technology centered focus to a customer focus will take significant time and effort. Donors can add value by including customer relations issues and outreach efforts in the capacity building and technical assistance they offer to developing countries as part of the overall restructuring and commercialization program.

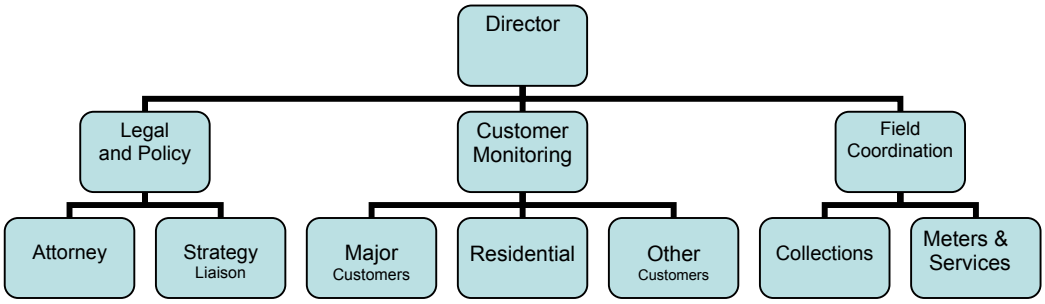
Organizational Issues to Improve Collections

An effective way for utilities to improve collections is by designating a specific entity in the company to focus on collections. However, the unit must have a high level of authority within the company; it should not be "buried" in the Accounting Department. "Revenue Protection" may be an appropriate name for such an organization, since it should be responsible for detecting and preventing theft, as well as for monitoring and collecting overdue accounts. Customers disconnected for non-payment often resort to theft in order to obtain electricity. Duties of such an organization would include:

- Monitor accounts receivable on a continuous basis, such as:
  - Overdue accounts by class of customer
  - Specific attention to the largest customers
  - Status of customer security deposits in relation to amounts owed
- Develop statistics to effectively monitor accounts receivable and disseminate information to the rest of the management team including:
  - Days Sales Outstanding by customer class with comparison to prior periods
  - Aging of A/R by class
  - Specific information for each of the 20 largest customers
  - Customers disconnected for non-payment (current period and year-to-date)
- Customers reconnected following resolution of arrears
- Determine when collection actions (reminder notices, follow up-notices, disconnection notices, disconnection orders, etc) should be taken based on customer class.
- Coordinate the collection action efforts of the other organizations. For example, Metering, Security, Billing, Legal, and Service Connection/Disconnection Teams.
- Develop collection-related policies for management (and possibly for approval by the regulatory body).
- Monitor collection policy compliance throughout the organization. For example, check customer credit histories when they apply for service, and complete service disconnection orders on a timely basis.
- Communicate to senior management the implementation impediments for a revenue collection program. For example, interference by politicians and government officials, and problems encountered with the court system in enforcing collections and disconnections, should be reported on a timely basis.

The organization structure of the Revenue Protection Department could be as shown in Figure 8-4.

Figure 8- 4 Revenue Protection Department Organization Structure



The Legal and Policy Division would consist of a legal staff responsible for protecting the company's interest by monitoring legislation, bringing legal action against non-paying customers, and advising company management. Legal staff would also draft company policies and ensure compliance.

The Customer Monitoring Division would be responsible for continuously monitoring Accounts Receivable and customer deposits, as well as reporting Key Performance Measures to the rest of the company. Specific groups would handle Major Customers, Residential Customers, and other (commercial, small industrial, state and local, etc.) customers.

Field Coordination would perform field collection activities, monitor meters and service connections for tampering, and disconnect and reconnect customers.

Incentive Compensation can be an effective tool to motivate Revenue Protection Department personnel (and other company employees) to perform more effectively. As discussed above, the incentive plan for bill writers at a Mongolian distribution company proved to effectively motivate employee performance. Key Performance Measures (KPMs) should be established and may include such metrics as:

- Reduction in Days Sales Outstanding by Customer Class and in total
- Number of customers disconnected by customer class
- Amounts collected from customers more than 60 days in arrears

Actual performance on the various KPMs could be the basis for the incentive compensation (pay for performance) program.

The Revenue Protection organization could be a specific organization reporting to a high level manager as discussed above, or it could be a cross functional team reporting to a senior management committee drawing on the resources of multiple departments including Sales, Billing, Legal, Metering, etc. The organization should have easy access to the Customer Information System in order to effectively carry out its mission. The CIS should not be considered a "proprietary" system for the Accounting or Billing Department, but rather a corporate resource.

Summary

Collections are a primary issue for distribution companies. From a business point of view, the distribution company is billing customers for its own costs (the "wires" and retail supply components), in addition to generation and transmission costs that may represent 70% of the cost to the retail consumer. Distribution companies therefore operate on a thin margin, and the ability to collect from customers is the primary key to survival. In many developing countries, the inability of distribution companies to collect cash has had a very negative impact on all reform measures in the sector.

The benefits of energy sector restructuring and tariff reforms will be severely limited until cash payments from all customer classes reach reasonable commercial levels. Otherwise, the lack of discipline through theft and non-payment will destroy any reform effort since the consumer can realize the ultimate subsidy. When the legal, regulatory, political, social, or corporate climate allows such behavior, electricity is essentially being treated as a free good.

This chapter highlighted the various environments in which distribution companies operate, including the legal, political, social, and regulatory aspects. A strong and enforceable energy law is of primary importance to facilitate the job of distribution company managers. Other laws must also recognize the evolving commercial status of the energy sector. Aside from legal issues, politicians, government ministries, and the general public must recognize the new commercial status of the industry. The regulator and the distribution companies should take every opportunity to educate the public. This will take time since the electricity sectors in developing countries have to change long-held perceptions.

Once the legal and structural framework is in place, improvement in collections is basically up to the companies themselves. That is why this chapter heavily emphasizes the corporate management aspects of collections. The application of sound commercial business management principles by the management teams is the real key to improving collections, and therefore the overall health of the energy sector. In this way, donors must recognize the importance of skill development in business management, in addition to the industry and regulatory structural issues, when determining areas in which to provide technical assistance. Also, effectively dealing with customers is critical to every business, especially energy sector companies.

Case Studies

Throughout the chapter, we have presented brief examples from various countries to illustrate specific practices and experiences. In this section, we offer more in-depth examples to provide additional insight regarding collection issues.

Darkhan-Selenge (Mongolia) Electricity Distribution Network
Darkhan Selenge Electricity Distribution Network (DSEDN) is a distribution and retail supply licensee in northern Mongolia. The company serves an industrial city and the surrounding area. It has approximately 33,000 residential and 2,000 industrial and commercial customers. Annual sales are approximately 116 GWh, with 22% to the Khutul Cement Company and 16% to a steel processing company. The management team of DSEDN undertook various initiatives to improve collections in the residential and industrial sectors. They worked closely with the large customers to understand the reasons for their slow payments, and attempt to develop a payment plan to reduce the debt. PA Consulting was working with DSEDN on a variety of

commercialization issues and the company asked the advisor to work specifically with the management team to attempt to resolve the 1.3 million US Dollar debt owed to it by the Khutul Cement Company, a state-owned enterprise. Following is an excerpt from a letter written by the advisor to the State Property Committee, the governmental unit responsible for managing the government's interest in the entities it owns. It illustrates the fact that the distribution company worked very closely with the customer over a period of time; however, the time had come for the government to step in to resolve the significant economic repercussions.

EXCERPT OF A 27 FEBRUARY 2003 LETTER TO THE STATE PROPERTY COMMITTEE

To: State Property Committee
Cc: Mr. Tserendamba, DSEDN
Mr. Dovdondorj, Khutul Cement Company

As advisor to the State Property Committee on Energy Sector Commercialization issues, I would like to bring a very significant issue to your attention. I have recently been working with Darkhan Selenge Electricity Distribution Network (DSEDN) to implement various recommendations contained in the Commercialization Report. One of the important tasks is to collect accounts receivable from the entity customers. As part of our capacity building efforts, we have been discussing the importance of managing accounts receivable and dealing effectively with customers in order to operate in a commercial environment. Mr. Tserendamba asked me to work with him and his management team to deal with the situation of the large debt owed to DSEDN by the Khutul Cement Chalk Co, its largest customer.

The senior management teams of both companies have been communicating on a regular basis and are interested in understanding each other's business issues and concerns, a very important part of customer relations. They seem to have a good business relationship, developed over a period of time. The issues of the ability of Khutul Cement to (1) satisfy its outstanding debt to DSEDN of over 1.3 billion Tg and, (2) be able to pay for future consumption are ones that must be addressed at the highest levels of the Mongolian Government.

On 26 February, Mr. Tserendamba and I met with Mr. Dovdondorj to discuss the situation of the outstanding debts and the ability of Khutul Cement to pay for future consumption. Mr. Dovdondorj was very helpful in providing information on the status of his company. Although he was not able to provide us copies of the financial statements, he did provide key information to give us a reasonable picture of the financial, operational, and business outlook for the company.

In May 2001, the company was spun off from the Erdenet Concern as a State Owned enterprise. It was severely under capitalized with negative Working Capital and negative Equity. The company was, by anyone's definition, a bankrupt enterprise from the beginning. This is further emphasized in the composition of its Governing Board, with a membership that closely resembles a "Creditor's Committee". At 31 December 2002, the company had 0.9 billion Tg of Accounts Receivable and 4.5 billion of Accounts Payable, including 1.3 billion Tg owed to DSEDN, resulting in a large negative working capital.

Mr. Dovdondorj indicated that annual breakeven volumes are approximately 125,000 tons for cement and 42,000 tons for lime. Actual volumes in recent years have been significantly below these levels, resulting in losses of 3.3 billion Tg, 1.5 billion Tg, and 0.8 billion Tg for the years 2000 through 2002 respectively. Of additional concern, is that the company does not plan to operate above breakeven in 2003.

In order to understand the market situation of the company's main product of cement, we discussed the demand for cement in Mongolia. The approximate domestic demand is 230,000 tons, with supply consisting of approximately 75,000 tons from Khutul Cement, 75,000 tons from Darkhan Cement, and the remainder of 80,000 tons imported, primarily from China. If domestic supply were to displace imports, the company could operate at volumes above the breakeven level.

DSEDN desires to operate as a commercial entity. Prudent business practices dictate that they should deal with Khutul Cement as a bankrupt entity. It is in the best interest of DSEDN to work with Khutul Cement to retain them as a customer. At the same time, DSEDN must protect its financial interests and not allow its major customer's debt to continue to grow, given that there is very low probability that the customer will be able to pay. A typical business practice in dealing with bankrupt customers is FIRST to discontinue granting additional credit and SECOND to agree with the customer on a schedule to repay past debt. Again, it is in the best interest of DSEDN for the customer to continue operating in order that future sales can be made. To allow the customer to continue receiving electric service, a common practice is for the customer to pay IN ADVANCE for the service on a weekly, monthly, or other basis.

On 24 February 2003, DSEDN issued a Notice of Disconnection to Khutul Cement that, due to non-payment (in the amount of 1.3 billion Tg), electric service will be discontinued on 03 March at 13:00. If the Government of Mongolia desires to have the cement company continue to operate, it is very apparent that the Government must provide a subsidy. In effect, DSEDN has been providing a "subsidy" to the cement factory by providing electricity without receiving payment. As you know, this is not in accordance with the State Property Committee desire to have the energy sector companies operate as commercial enterprises.

In the short-term, Government support to the cement company must be in the form of transparent direct cash subsidies to allow the company to pay for electricity and raw materials to restart the cement operations. Longer-term measures may have to involve import quotas or other measures to allow the company to survive. Those measure, of course, are subject to the Country's overall economic and trade policies.

During the year 2002, DSEDN disconnected Khutul Cement on three separate occasions for non-payment. The disconnections lasted for short periods of time, however, due to pressure exerted by various Government Ministries with no payment provided. As you know, in our various Commercialization Reports prepared for the Companies and the SPC, recommendations were made as follows:

"The Government of Mongolia should discontinue the practice of having a list of entities that it will not allow suppliers to disconnect. The Government should not use the energy sector to provide non-transparent subsidies to those entities"
"The Government of Mongolia should allow licensees to take more vigorous collection action with retail customers, including State Owned and Budget Entities"

To support our commercialization efforts in the energy sector and to promote rational industrial policy, DSEDN must be able to exercise its right, clearly spelled out in the Law of Mongolia on Energy, to deal with customers in a commercial manner. I understand that one issue frequently brought up in relation to disconnection of Khutul Cement is the fact that electricity is required to operate the heating plant that is fed from the same circuit. As an issue of great public concern, the heating plant should be allowed to operate and, therefore, sufficient quantities of electricity can be supplied for that purpose, however, not to the cement company for other purposes.

I am available to discuss these issues with you at your convenience.

DSEDN followed through with the disconnection on 03 March. On 19 March, the State Secretary of the Ministry of Infrastructure sent a letter to DSEDN "ordering" the reconnection of the Khutul Cement Company. This example illustrates that all the dimensions (legal, political, regulatory, and management) must be addressed in order to be successful in collecting cash. The Energy Law was adequate, the Energy Regulatory Authority was in agreement with the disconnection, the company management team applied solid business principles; however, the political situation was a barrier that could not be overcome.

The following letter from DSEDN to the State Property Committee in May 2003 discusses the deteriorating situation experienced by the distribution company and the fact that it is unable to pay for the power delivered from various power stations. It requested the government to allow it to borrow from commercial banks with the debt guaranteed by the large customers.

EXCERPT OF A 22 MAY 2003 LETTER TO THE STATE PROPERTY COMMITTEE

To: State Property Committee
From: DSEDN

At 1 May 2003, the Accounts Receivable of the company consists of MNT 3,463.9 million from entities, MNT 1,735.3 million from households and MNT 282.9 million from budgetary institutions. Compared with the same period of last year, this is an increase by MNT 2,104.2 million.

At this date we owe MNT 884.7 million to Darkhan power plant, MNT 4,675.5 million to UB PP-4 and MNT 843.2 million to the "zero" balance account of the Single Buyer (Transmission company). It means we need additional sources of MNT 1,468.6 million in order to sustain in 2003.

The Accounts Receivable occupy 40.2% of the total assets. Receivable of MNT 1,596.2 million from the Khutul Cement Chalk Co. Ltd. is 28.9% of the total Accounts Receivable and 45.7% of the receivable from entities, while the

receivable of MNT 1,053.4 million of the Metallurgical plant occupies 19.2 of the total and 30.0% of the entities total.

Meetings with those customers had been held several times (18 times with the Metallurgical plant and 6 times with the Khutul Cement Chalk company) discussing on debt reduction and signing the agreements on schedules of debt reduction. Unfortunately, these customers are reluctant to meet their obligations and to initiate the process of lowering the debt. The result is an increased balance of their debt.

In compliances with the clause 32.2 of the Energy Law, the DSEDN has a right to disconnect electricity of those customers, however, such an action is postponed due to requests from higher governmental institutions. The company cannot operate in this manner any more.

The above-mentioned customers do not pay for current consumption or pay not full amounts resulting in an increase in the Accounts Receivable and lowering collection rate and undermining the company's financial sustainability.

The company failed to transfer MNT 700 million to "zero" balance account as of 1 May 2003. The payable to the "zero" account is even higher including penalties. The company faces shortage of funds as financing sources depend on our contributions to the market.

In order to overcome the shortage, the company needs to borrow MNT 800 million from commercial banks for 3 months.
Therefore, please permit us to borrow based on loan guarantees to be issued by the Khutul Cement Chalk company and the Metallurgical plant. We do expect assistance and support from your side in resolving the debt issue of two customers.

The government, however, did not grant the company's request.

Eastern Energy System of Mongolia

Eastern Energy System (EES) is a unique company in the Mongolian energy sector since it is the only bundled utility providing generation, transmission, distribution, and retail supply of both electricity and heat. In addition, it operates as an "electrical island", having no interconnection with the other energy sector participants in Mongolia or with the Russian Grid. This creates a different environment and a different set of challenges for EES.

EES is a small company with approximately 7,300 residential customers. Its management team has taken significant steps to improve billing and collections. Their objective is to accurately bill customers on a monthly basis and collect the amounts billed. Bill writers are responsible for reading each customer's meter each month, and giving a bill to the customer at that time. Payment terms for households require bill payment within 30 days.

EES has a very good quality control mechanism in place to monitor the usage of the customers fed off each circuit (utilizing meters at the substations), and then compare that to the kWh billed by the bill writer each month. This provides management a tool to follow up with each bill writer to investigate amounts close to the total not billed. Besides identifying those bill writers that may be understating customer usage, the system also identifies circuits where there may be

high technical losses, meter tampering, or other forms of theft. Table 8-3 is an excerpt from a report showing the monthly results for one of the bill writers, including the energy delivered from the substation, energy billed, and the resulting billing percentage. The incentive compensation of meter readers is based on the billing percentage they achieve. This is a very innovative and progressive program that the company continues to use and improve.

Table 8-3 Billing Performance by Meter Reader

meter reader	Month	Delivered electricity thous.kWh	Billed electricity thous.kWh			Lost electricity thous.kWh	Billing percentage
			entity	household	total		
Meter Reader #1	January	89,030	8,485	63,047	71,532	(17,498)	80.3
	February	86,900	10,048	57,716	67,764	(19,136)	78.0
	March	75,700	6,389	56,603	62,992	(12,708)	83.2
	April	74,600	6,453	58,243	64,696	(9,904)	86.7
	May	73,632	6,727	55,749	62,476	(11,157)	84.8
	June	68,840	5,295	55,644	60,939	(7,901)	88.5
	July	64,660	4,302	52,840	57,142	(7,518)	88.4
	August	61,905	3,154	54,990	58,144	(3,762)	93.9
	September	65,029	4,509	51,945	56,454	(8,575)	86.8
	October	68,598	5,661	54,749	60,410	(8,189)	88.1
	November	72,401	6,988	58,498	65,486	(6,915)	90.4
	December	73,371	9,386	55,126	64,512	(8,859)	87.9
	Annual	874,667	77,396	675,150	752,546	(122,121)	86.0

Collection of the amounts billed is the next step in this process. Table 8-4 is an excerpt from a report that displays the aging of accounts receivable by meter reader as of 01 May 2002, with a comparison to the prior year-end.

Table 8-4 Aging of Accounts Receivable by Meter Reader

(Amounts in thousands of Mongolian Togrog)

Meter reader's name	30 days	60 days	90 days	120 days	more than 120 days	Total 2002.5.01	as of 2001.12. 31
Meter Reader #1	2,398	1,251	560	256	1,100	5,565	5,566
%	43.1	22.5	10.1	4.6	19.8	100.0	
Meter Reader #2	2,980	1,372	660	375	1,200	6,586	6,372
%	45.2	20.8	10.0	5.7	18.2	100.0	
Meter Reader #3	1,456	691	381	266	989	3,783	3,934
%	38.5	18.3	10.1	7.0	26.1	100.0	
Meter Reader #4	1,880	469	695	1,063	264	4,371	3,844
%	43.0	10.7	15.9	24.3	6.0	100.0	
Meter Reader #5	1,183	2,354	1,296	2,150	200	7,182	6,782
%	16.5	32.8	18.0	29.9	2.8	100.0	

The company, therefore, has a picture of the composition of the accounts receivable in each meter reader's area.

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