Chapter 14
Growing Complexity and Transformations of the Power Sector:
India as an Example of Developing Regions using Enterprise Architecture and Smart Grids

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ABSTRACT

Enterprise Architecture (EA) can be thought of as a powerful tool to transform electricity (distribution) utilities into more service-oriented and also economically viable enterprises, if not sustainable enterprises (spanning the so-called triple-bottom-line, viz., profits, people, planet). Developing regions (such as India) face even greater challenges than global concerns about electricity. Developing regions' utilities are often loss making and have numerous operational challenges (including high theft and a weak/unstable grid). They also face a populace with limited means to pay (putting pressures on pricing) but also a large swath of potential consumers whom they have not yet reached. The rise of Information and Communications Technology (ICT) offers the ability to know what (and how much) is going where, with high time and geographic precision, covering not merely flows of electricity but also money, information, control, manpower, etc. More than converting data into information, it can lead to improved decision-making ("knowledge" and "wisdom"). Ultimately, harnessing ICT not only speeds up processes, but also transforms the enterprise. The widest-reaching form of EA transformation has been called a Smart Grid, an ongoing transformation of utilities worldwide. EA done right is complex, but so is electricity distribution. Instead of hiding or ignoring complexities, EA internalizes them into the decision-making process. While decision-makers cannot ignore issues of political economy, an Enterprise Architecture lens focuses on incentives, operations, and planning important for all enterprises independent of public versus private ownership.

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INTRODUCTION: ELECTRICITY AND ENTERPRISE ARCHITECTURE

Electricity is, in many ways, a century older than the modern high-tech IT industry (or ICT, Information and Communications Technology industry). People have regularly marveled that if Edison (rather Westinghouse or Tesla, who pushed for alternating current, or AC, for the power grid) were to visit a power grid today, they would find it rather similar. Admittedly, the distances are longer, voltages are higher, and, of course, consumption is vastly differently. But, the underlying system looks rather similar. On the other hand, Alexander Graham Bell would scarcely recognize modern communications, which have moved away from corded, analog phone lines (which are still important) to wireless, digital, and the Internet.

So what does Enterprise Architecture (EA) have to do with the power sector? To those applying a narrow engineering lens, it is a tool and perhaps an add-on to how to operate a power grid. However, there is evidence to show that EA is a core part of power systems, or at least should be.

Electricity faces enormous challenges, worldwide. It is on the order of only 3% percent of the global GDP, but a number of publications point to its disproportionate value, impacting not only the GDP (strongly correlated) but also quality of life.

The challenges vary by country and level of development, though all countries worry about security of supply, and, of course, economics. There is widespread and growing concern about environmental implications as well. While carbon emissions and global climate change have gathered much of the press, local pollution (land, air, and water) are also equally critical. Worries about radiation, e.g., have led to a slowdown if not reversal of nuclear power in a number of countries.

But in developing regions, the challenges are far greater, for several reasons. First, the price per kilowatt-hour (kWh) isn't much lower than in developed regions (or at least cost, if not price), while incomes are much, much, lower. Thus, while in the US, the average household may spend 1.98% of their income on electricity,[1] in India, the *average* number might be slightly lower but doesn't factor in full costs, not to mention this is with very low per-capita consumption, some 20 times lower than the US.[2] In addition, a very substantial fraction of the population (1/3 of homes, likely more of the population given rural households are larger) doesn't have access to electricity (Census Commission, 2011). In India, Africa, and other regions with access difficulties, it is not just that the electricity doesn't reach the home (or, sometimes, the village) but even when there is a wire, it may not be carrying electricity – outages ("load-shedding") are common.

There are several other drivers for increased use of modern ICT and revamped Enterprise Architecture. Concerns and pressure for greener energy make IT not only an enabler but a driver for change (Bengtsson & Agerfalk, 2010). New services along the value chain (Wissner, 2011) including not just renewable power but home automation and control are increasingly being envisaged, especially for regions with an aging population and/or high labor costs.

The first portion of this chapter begins with an overview of the current electricity sector, and ongoing changes and reforms. The second portion brings in the concepts of Enterprise Architecture. We then examine some more detailed specifics and implications of EA, ending with a brief examination of Smart Grids, a term describing an ICT and control driven power system.

There are many sub-portions of each of these topics, many of which have their own books, e.g., Political Economy and Reform of power systems. There are also a number of books on IT for the Power Sector, and Smart Grids. This chapter aims to cross across domains and present an integrated view of EA for the power sector. Given the enormous scope of this, we choose India as a representative example of developing regions,