The Impact of Supply Chain Resilience on the Business Case for Smart Meter Installation

To produce realistic cost benefit assessments for the rollout of electricity smart meters, financial and operational decision-makers can collaborate using the framework of operational excellence and supply chain resilience. Strategies of product standardization, installation cost unification, onsite uncertainty reduction, and binding investments deferral not only reduce electricity supply chain vulnerabilities but also provide considerable cost reduction and resource optimization.

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I. Introduction

The 20-20-20 targets of the European Union's energy policy mandates that member states by the year 2020 achieve a 20 percent reduction in greenhouse gas emissions compared to 1990 levels, a 20 percent reduction in primary energy use through improved energy efficiency, and a 20 percent proportion of renewable energy sources out of total energy consumption (European Commission, 2010; The European Union, 2009). In order to reach these targets, consumers must be effectively and frequently informed about their actual consumption and costs by way of smart electricity meters so they are able them to regulate their own electricity consumption. Consequently, the member states were obliged to produce cost benefit assessments (CBA) for the rollout of electricity smart meters by September 2012. According to EU Commission (2010), the corresponding member state would have to invest in smart meters in case of a positive or no CBA. Surprisingly, ERGEG (2011) claims that by February 2011 only 11 out of 27 European Union countries had provided electricity smart meter business cases and the CBA results have been positive in only seven countries. Instead of focusing on attaining a maximum degree of operational efficiencies, the majority of such studies reveal conservative worst-case scenarios (see BERR, 2007; Renner et al., 2011; Schrijner et al., 2008; Wing et al., 2009), which in turn can hamper the feasibility and economic viability of smart meter implementation projects. Therefore, the need for a realistic smart meter rollout project design and assessment to avoid cost overestimation and benefit underestimation is evident. On the other hand, the electricity networks represent some of the most sophisticated supply chains in existence, performing at very close to 100 percent service levels. Also, the expected speed of recovery from an unlikely blackout warrants a highly resilient supply chain (ELCON, 2004). In this research, we have collaborated with a major European distribution system operator (DSO) in charge of assessment and – in the event of positive results – implementation of a major smart electricity and gas meter rollout project in Belgium. Acknowledging the importance of robustness and resilience of electricity supply chains, the DSO's ultimate objective was to generate the most realistic CBA of the project taking into consideration the principles of lean operations and resilient supply chains. Thus, we worked on a complete multi-phase, multi-year smart meter rollout project plan that included the dynamic evaluation and improvement of the project CBA. In phase 1, DSO engineers used their extensive field experience to build a model and estimate its parameters to capture the cost elements of exchanging current meters for smart ones over a period of five years. We then used existing studies such as Faruqui (2009) and Faruqui et al. (2009) to summarize the potential short- and long-term benefits of such projects. In phase 2, following the principles of resilient supply chains at Christopher and Peck (2004) and Sheffi (2007), we identified five classes of vulnerabilities (process, control, demand, supply, and environment) in executing the plan. With the objective of achieving maximum operational efficiency and minimum execution cost, we proposed four strategies to ideally avoid or at least reduce vulnerabilities. We selected strategies of product standardization, installation cost unification, onsite uncertainty reduction, and binding investment postponement, and translated these into specific operational decisions. We quantified the cost reduction impacts of these strategies during the micro-rollout of electricity meters among 0.12 percent of the total installation locations, performed in the second quarter of 2011. The DSO engineers then calibrated the original model parameters prior to presenting the final positive CBA to the European authorities by the September 2012 deadline. In this article, we have summarized the cost reduction achievements till the end of the second phase. In phase 3, the DSO is conducting a pilot mini-rollout project in 1.2 percent of installation locations with the objective of identifying more operational efficiencies and hence cost reduction opportunities. In phase 4, the final phase, the multi-year smart meter rollout project will be executed with optimized operational planning and cost structure. We identify 20 vulnerability items in the context of the smart meter rollout project and categorize them in five classes, as illustrated in **Table 1**.

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To avoid or reduce vulnerability in the smart meter rollout project, we propose four distinct operational strategies that

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