

COSTS AND BENEFITS OF INTEROPERABLE SOFTWARE IN THE NORTH AMERICAN ELECTRIC POWER GRID

by Rik Drummond

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Interoperability is becoming more important in many industries, as the need for information sharing becomes vital to competitiveness. One sector where interoperability is a major focus is the North American electric power industry, which boasts revenues of approximately \$350 billion per year.

There are studies for other industries examining return on investment, savings, or cost avoidance for implementing interoperability. There are currently no such studies for the North American electric power grid. Can we use studies from other industries to estimate the payback or cost savings value of wide-scale interoperability in the North American electric power grid? To answer this question, consider the following:

Each industry is unique in the intra- and inter-organizational processes that influence the direct and indirect benefits of interoperable software and thus interoperable cross business processes.

Implementing any new endeavor always has both direct and indirect consequences, especially in a very large supply chain. The direct intended consequences are the initial reasons for implementation. The indirect consequences are hard to discretely estimate; however their impact is often much larger than the direct consequences. For example, who would have thought 20 years ago that TV cable providers would provide a better way to network the home than the telecom experts (the phone companies). Or that the power system could be used for digital networking in its own right (broadband over powerline)?

Comparing information between dissimilar industries has inherent inaccuracies due to differences in organizational processes, network communications topologies, embedded software and equipment, not to mention different data collection techniques between the studies.

Even so, a comparison can be meaningful if one is careful in aligning the studies. We are going to use three studies, one from the power industry and two from the National Institute for Standards and Technologies (NIST) to estimate of the value of interoperability:

1. Estimating the Benefits of the GridWise Initiative Phase I Report (RAND Science and Technology Technical Report, ISBN: 0-8330-3641-6), 2004, WALTER S. BAER, BRENT FULTON, SERGEJ MAHNOVSKI, Prepared for the Pacific Northwest National Laboratory
2. The Economic Impacts of Inadequate Infrastructure for Software Testing, May 2002, National Institute of Standards, by RTI – Health, Social, and Economics Research
3. Cost Analysis of Inadequate Interoperability in the US Capital Facilities Industry, 2004, National Institute of Standards, Michael P. Gallaher, Alan C. O'Connor, John L. Dettbarn, Jr., and Linda T. Gilday, NIST GCR 04-867

Aligning the studies

Aligning these three studies for comparison will first require conversion of the payback metrics to a percent of revenue in the industries under study. The RAND study is for payback over a 20-year period, while both NIST studies are based on single year payback.

The two studies from NIST focus on the costs arising from a lack of general software testing and/or interoperability in industries such as aerospace, automotive, capital facilities and financial services.

The power industry study, performed in 2004 by RAND Corporation, did not study interoperability payback *per se*. Rather, it looked at the benefits of an innovative program that would require interoperability to accomplish. The RAND study looked at the payback for implementing a program throughout the North American power grid. That program would implement an infrastructure to allow consumers to purchase electricity at moment-by-moment real market prices instead of today's one-size-fits-all market average cost. By varying prices, utilities would cause consumers to use less electricity at peak times, when it is most difficult and costly to provide. Consumers can voluntarily choose to lower usage during peak demand periods when the price per kilowatt hour is 10-20 times that of non-peak times. This mechanism is called "demand response" because it allows utilities to respond to increased power needs by reducing demand rather than increasing supply.

A demand response infrastructure would require interoperable smart meters installed on customer premises as well as an interoperable IT infrastructure. From this requirement comes our ability to use the savings from the program as a proxy for interoperability benefits. The RAND study indirectly measures part of the value from the interoperability that the program would require.

Comparing the three studies

Analysis shows that direct cost savings are in the same range for all three studies. What's more, indirect savings are expected to be sizable in all three studies as well. In brief, implementing interoperability for the North American

power grid would have the same or more direct benefits as the implementation of the 'demand response' program in the RAND study.

For purposes of comparison, the study numbers have been converted to a percent of revenue of the North American grid, and normalized to one year using net present value. The RAND study showed a range of savings across five different scenarios. The lowest savings was 0.34% of total revenue and the highest was 1.42%. These numbers will establish our range limits for comparison of this study to the other two.

The lack of interoperability between products from different vendors is costly to the end users. The expectation of interoperability problems greatly lengthens the purchasing process, because it creates the need for presales, product trials and technical investigations. It promotes the installation of mitigation processes plus the purchase of software and hardware to be used in case of communication failures. Extra person-power is required to fix problems and to find work-a-rounds. (Code patches in products in the field are very costly.)

In addition, the absence of interoperability has indirect costs:

- ▶ Lost business during down time
- ▶ Lost productivity of staff
- ▶ Inability to build products
- ▶ Loss of company image, etc.

The NIST "Economic Impacts" report was not on interoperability per say, but on the lack of a software testing infrastructure and the costs to the U.S. economy. Although interoperability testing is only a subset of all software testing, these figures provide us with a range of impact for an industry as well as an estimated impact on the economy as a whole.

That NIST study shows a range of savings (as a percentage of revenue of the industries studied). The low was 0.19% and the high 0.49%. In addition, a survey of experts concluded there was a possible high of 1%, or about \$120B per year. This figure is probably on the low side, since it does not consider indirect costs.

The NIST "Cost Analysis" study examines interoperability as it applies to the U.S. capital facilities industry. It estimates a range of impacts, with a high of 4.2% of revenues. To be fair, this may not precisely match the environment of the other industries, since this sector is composed of companies working together on an ad hoc basis (not on a continuous basis). One could argue that type of industry would experience more interoperability problems than most others.

The Savings

Now, for our purposes, the three studies are aligned financially and can be compared. There are several discrepancies, which one would expect since

different methodologies were used in each to collect and analyze the resulting data. The table below shows the low and high range of each study.

Study Comparison

Cost avoidance or savings as a % of total grid yearly revenues

Rand		NIST Testing		NIST Interop	
Low	High	Low	High	Low	High
0.34%	1.42%	0.19%	0.49%	n/a	4.2%
\$1.02B	\$4.26B	\$0.57B	\$1.47B	n/a	\$12.6B

A possible discrepancy between the NIST studies is that interoperability could be thought of as a subset of software testing; yet interoperability shows a higher savings, or payback, than all of testing. If you consider interoperability as nothing more than part of testing, then this finding is counterintuitive. However, both studies show the same magnitude of savings, demonstrating that both studies are focusing in on the issues and that their analysis is relevant for our analysis.

Conclusions

In conclusion, the RAND study of a demand response infrastructure showed an annual high savings of 1.42% on a revenue stream of about \$350B. The NIST testing infrastructure study showed a “found high” of 0.49% and an “expert projected intuitive high” of 1%. And the NIST interoperability study showed high savings approximately three times more than the RAND study. But since we are dealing in ranges, we can derive two conclusions from this comparison:

First, wide scale interoperable software for the North American power grid would have the same value range if not more as the implementation of the demand response program in the RAND study.

Second, failure to ensure hardware and software interoperability would significantly reduce the payback of that demand response program (as it did in the other industries studied by NIST).

After spending significant time comparing these studies, I believe this comparison is valid. A well-orchestrated grid interoperability program could save up to 4% of grid revenues, or roughly \$12.6B per year.



This white paper is part of a collection of papers, case studies and Web pages devoted to the modernization of the North American electric power infrastructure. Visit Smart Grid News at www.smartgridnews.com for the latest grid news, free downloadable reports and a free bi-monthly email newsletter.

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