APB Methods

Ontario Energy Board

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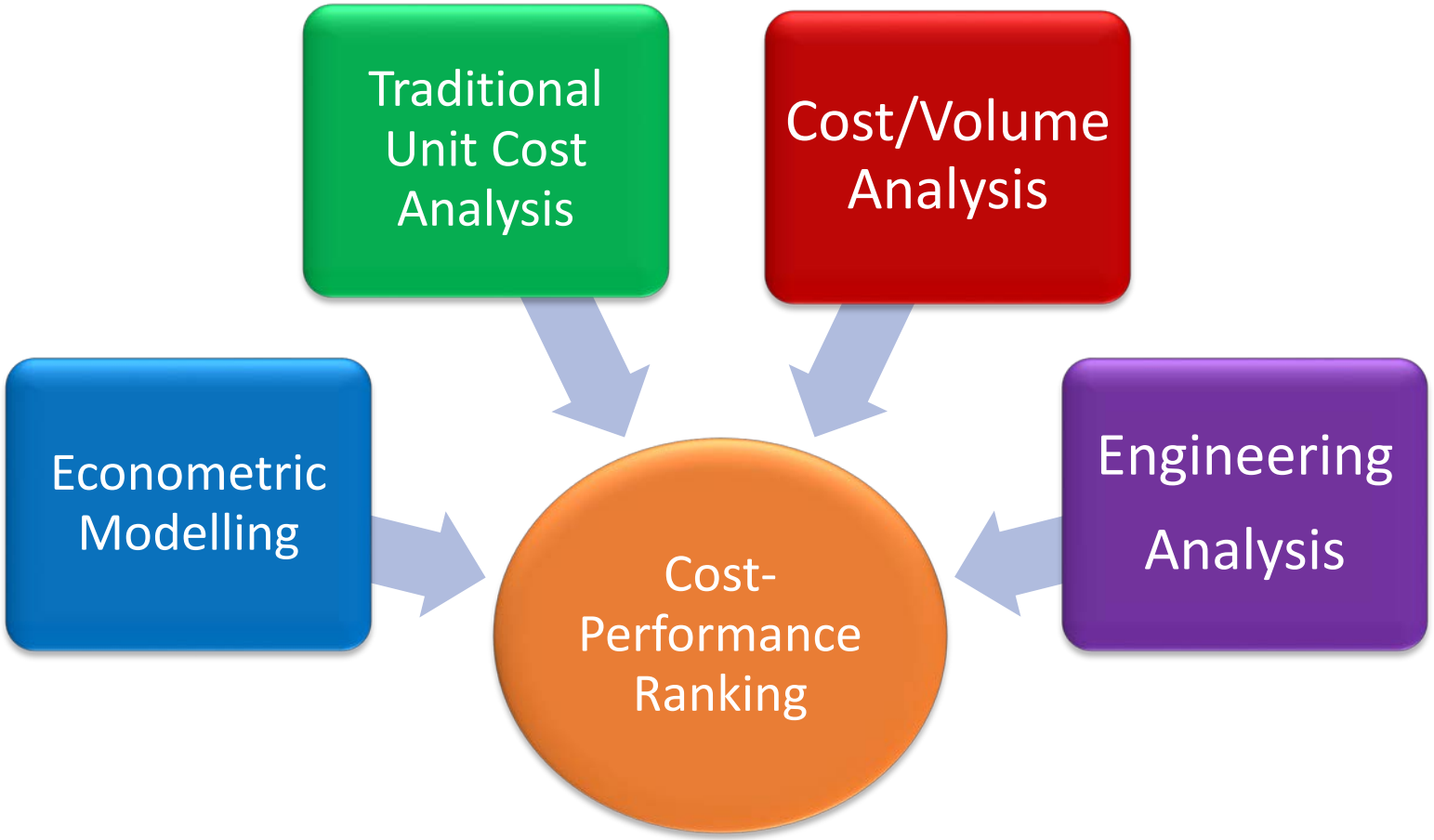
Methods Used for APB

Unit Cost Methods



Statistical Benchmarking

Statistical Benchmarking	Performance evaluation using data on operations of other utilities
Performance Metrics	Variables that measure company activities (e.g., Unit Cost)
Benchmarks	Comparison values for metrics which are drawn from data on other utilities Benchmarks ideally reflect business conditions (e.g., cost "drivers") that affect the values of performance metrics

Cost Drivers

Impact of business conditions on some *granular* costs are complicated

Example: Line O&M Expenses

Cost Function

Cost = f ($W^{O\&M}$, Y, Z, X)

Cost Drivers

$W^{O\&M}$	Prices of O&M inputs (e.g., labor)
Y	Scale variables (e.g., number of customers, line length)
Z	Other external business conditions (e.g., forestation, reliability standards)
X^{other}	Quantities and attributes of other (e.g., capital) inputs that utility uses (e.g., age of lines, share underground)

Unit Cost Benchmarking

Basic Idea

Benchmarking that uses unit cost metrics

Unit Cost = Cost/Scale

Two basic approaches

- Traditional Approach
- Cost/Volume Approach

Traditional Unit Cost Benchmarking

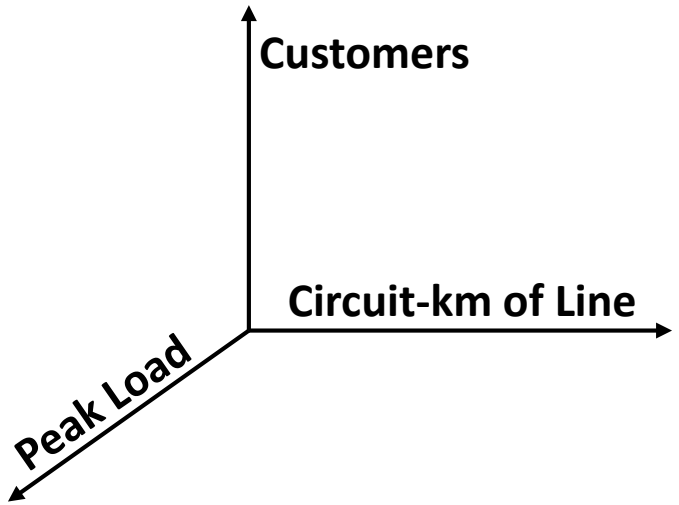
Ratio of cost to a measure of *general operating scale*

Unit Cost = Cost/Customer

Scale can be multi-dimensional

Multidimensional scale indexes can be developed

Econometric cost research can identify scale variables & assign weights



Example: Unit Cost Summary Table

Metric Result	Corresponding Performance
25%+ Below Average	Far Better than Average
0-25% Below Average	Better than Average
0-25% Above Average	High Cost
25%+ Above Average	Very High Cost

			Cost per Customer				Unit Cost Index			
Category	**2016 Cost Level**	**% of Total**	**$/Customer**	**Industry Average**	**Performance***	**Screening Result**	**$/Index**	**Industry Average**	**Performance***	**Screening Result**
Meter Expense (including maintenance)	$1,348,674.74	3.80%	$8.67	$9.93	-13.55%	**Better than Average**	$12.69	$14.37	-12.49%	**Better than Average**
Line Operation and Maintenance	$5,328,431.72	15.01%	$34.27	$46.42	-30.35%	**Far Better than Average**	$46.92	$63.11	-29.65%	**Far Better than Average**
Maintenance of Poles, Towers and Fixtures	$457,043.89	1.29%	$2.94	$4.83	-49.64%	**Far Better than Average**		$6.57		
Operation Supervision and Engineering	$1,890,311.92	5.33%	$12.16	$11.26	7.71%	**High Cost**				
Vegetation Management	$908,822.55	2.56%	$5.84	$15.53	-97.70%	**Far Better than Average**		$20.85		
Distribution Station Equipment	$735,110.13	2.07%	$4.73	$5.25	-10.43%	**Better than Average**		$5.25		
Billing Operations	$4,309,297.77	12.14%	$27.71	$56.98	-72.09%	**Far Better than Average**		$67.60		
General Expenses and Administration	$13,294,116.89	37.46%	$85.49	$116.83	-31.23%	**Far Better than Average**	$92.93	$126.83	-31.10%	**Far Better than Average**
Load Dispatching	$1,531,766.01	4.32%	$9.85	$5.05	66.72%	Very High Cost				
Miscellaneous Distribution Expense	$2,560,771.36	7.22%	$16.47	$12.47	27.81%	Very High Cost				
Maintenance Supervision and Engineering	$1,799,061.01	5.07%	$11.57	$4.41	96.51%	Very High Cost				
Other	$5,891,598.38	16.60%	$37.89	$21.93	54.67%	Very High Cost				

Traditional Unit Cost Benchmarking (*cont'd*)

Peer Groups

Accurate unit cost analysis sometimes requires *custom* peer groups that face similar pressures from other (non-scale) cost drivers

- e.g., input prices, forestation, undergrounding, reliability standards

Econometrics can guide peer group selection

- Are there other cost drivers?
- What is their relative importance?

Traditional Unit Cost Benchmarking (*cont'd*)

Advantages

Automatically controls for differences in most important cost driver (scale)

Easy to understand and interpret

Used by utilities in many internal benchmarking studies

Disadvantages

Doesn't control for *other* cost drivers

Custom peer groups and/or multidimensional scale indexes sometimes needed for accurate benchmarking

Cost/Volume Benchmarking

Some costs can be usefully decomposed into a volume and a cost/volume metric

e.g., *pole replacement capex*

= # poles replaced x (cost/pole replaced)

Cost/volume metrics can be compared to peer group norms

Common applications: capital expenditures, vegetation management

Cost/Volume Benchmarking (*cont'd*)

Advantages

Cost/volume metrics are often worth benchmarking

Easy to understand and interpret

Used by Australian & British regulators and many utilities

OEB has asked utilities to file unit cost benchmarking studies

Cost/Volume Benchmarking (*cont'd*)

Limitations

Some of the requisite data aren't currently gathered in Ontario

Accurate cost/volume analysis can require detailed data

e.g., pole replacement costs & volumes by type of pole

Prudence of cost depends on volumes, not just on cost/volume

e.g., # poles replaced

Econometric Benchmarking

Basic Idea

Econometric benchmarks can be calculated using

- Cost model with parameter estimates (e.g., b_0, b_1, b_2, b_3)
- Business conditions for subject utility

$$Cost^{Northstar} = b_0 + b_1 Price_{Labor}^{Northstar} + b_2 Customers^{Northstar} + b_3 System\ Age^{Northstar} + b_3 Trend$$

Econometric Model: Line O&M

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	T-STATISTIC	P Value
Scale Variables:			
Number of customers	0.556	14.262	< 2e-16
Circuit-km of line	0.482	14.381	< 2e-16
Other Business Conditions:			
Percentage change in number of customers over last ten years	-0.617	-2.874	0.004
Percentage of line that is overhead	0.717	12.509	< 2e-16
Time trend	-0.019	-2.711	0.004
Constant	4.233	112.281	< 2e-16

- 0.902 System Rbar-Squared
- 2013-2017 Sample Period

Parameter estimate is statistically significant at 95% confidence level

Econometric Benchmarking (*cont'd*)

Advantages

Generally more accurate due to…

Simultaneous consideration of multiple cost drivers

Model specification guided by

- Economic theory
- Statistical tests of parameter significance

Trend variable

Benchmarks reflect exact business conditions facing subject utility

No need for custom peer groups

OEB's large, growing dataset facilitates accurate model parameter estimates

Already used in Ontario

Econometric Benchmarking (*cont'd*)

Disadvantages

Number of variables that can be accurately modelled is limited

Knowledge of econometrics needed to produce and interpret results

Two seemingly reasonable models can produce different scores

>>> Perception by some of "black box" methodology

Method may lack credibility with utilities, discouraging use in cost management

Preliminary Empirical APB Research

PEG has done some preliminary econometric modelling using OEB data at various levels of granularity for OM&A expenses

Results

Sensible models can be developed

Explanatory power of models generally falls as granularity rises

Some granular costs are difficult to benchmark accurately

Conclusions

Ontario's regulatory community already has experience with most methods used in APB

Unit cost and econometric methods are complementary

Mix of benchmarking methods is advisable

- Unit cost methods will be used in most or all cases
- Econometric modelling can make unit cost research more effective (e.g. to develop multidimensional scale indexes) in addition to providing alternative appraisals

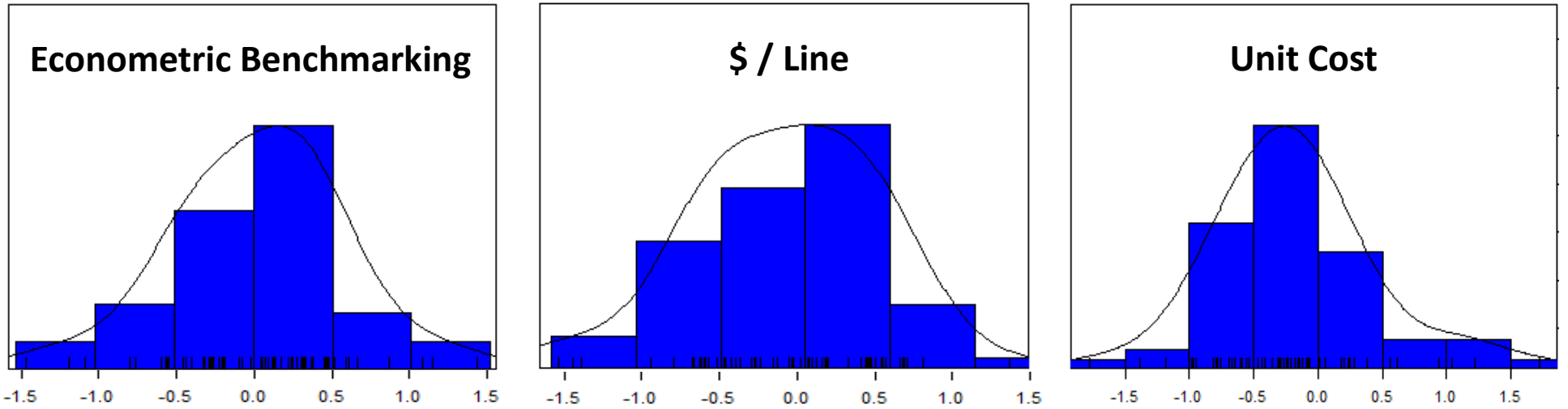
Appendix

Comparing Results Using 3 Benchmarking Methods: Line O&M Expenses

Spearman Rank Correlation Coefficients

	Econometrics	$/Line	Unit Cost
Econometrics	1	0.72	0.76
$/Line	0.72	1	0.70
Unit Cost	0.76	0.70	1

Histogram and Density Plots



Calculating Multidimensional Scale Indexes

e.g., Power Distribution O&M Expenses (Ontario data)

	Estimated Cost Elasticity	Elasticity Share
Customers	0.491	0.52
Deliveries	0.366	0.38
Line Miles	0.094	0.10
Total	0.951	1.00

$$\text{Unit Cost}^{\text{Northstar}} / \text{Unit Cost}^{\text{Peers}}$$

$$= (\text{Cost}^{\text{Northstar}} / \text{Output}^{\text{Northstar}}) / (\text{Cost}^{\text{Peers}} / \text{Output}^{\text{Peers}}) /$$

$$= (\text{Cost}^{\text{Northstar}} / \text{Cost}^{\text{Peers}}) /$$

$$[0.52 \times (\text{Customers}^{\text{Northstar}} / \text{Customers}^{\text{Peers}}) +$$

$$0.38 \times (\text{Deliveries}^{\text{Northstar}} / \text{Deliveries}^{\text{Peers}}) +$$

$$0.10 \times (\text{Miles}^{\text{Northstar}} / \text{Miles}^{\text{Peers}})]$$