



Interpreting Reliability Data

– More than meets the eye

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Presentation prepared for the IEEE PES Distribution Reliability Group
Joint Technical Committee Meeting (JTCM) January 7-11, 2018 • Jacksonville, FL, USA

Content developed as part of NEETRAC Baseline Project 17-048: Analysis and
Benchmarking Methods for Standard Reliability Indices

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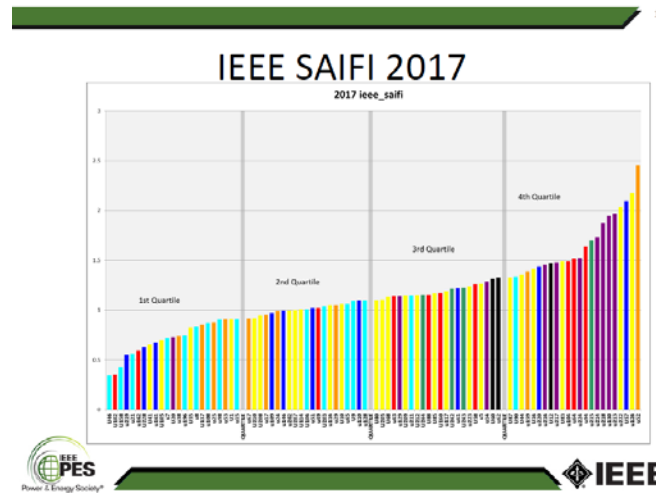
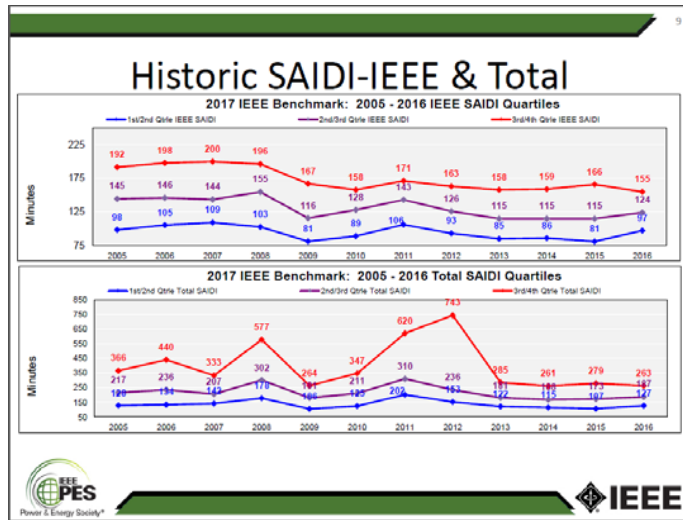
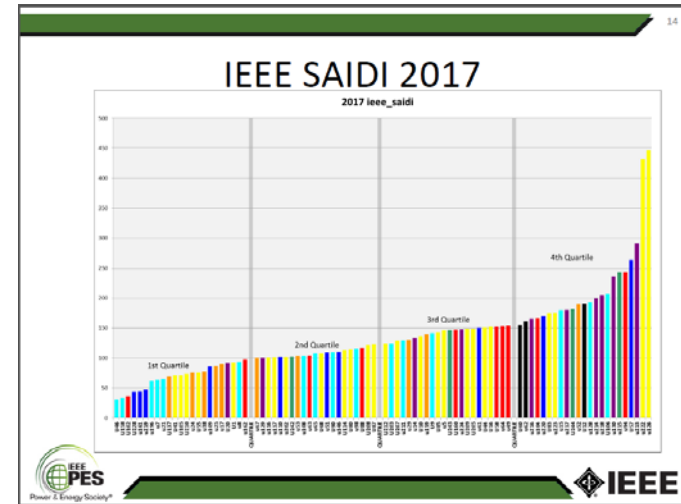
Purpose of the Study

- SAIDI, SAIFI, and CAIDI are defined indices used to describe electric service reliability
- Significant amount of data is made available by the IEEE DRWG
- NEETRAC proposes to develop analytical approaches that can be applied to these reliability indices to provide added value to the existing data:
 - Predict likely future results
 - Identify achievable improvements
 - Find appropriate benchmarking groups
 - Evaluate impact of practices behind the improving numbers

IEEE Information – Example

Respondents by Utility Size

Quartile	Small	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIFI ALL	SAIFI IEEE	SAIFI WOF	CAIDI ALL	CAIDI IEEE	CAIDI WOF
0	MIN	76	36	36	0.74	0.36	0.36	88	82	67
1	Q1	127	110	62	1.21	1.15	0.63	102	102	69
2	MEDIAN	177	149	141	1.43	1.34	1.08	126	112	80
3	Q3	263	166	149	2.10	1.49	1.13	129	126	81
4	MAX	402	263	179	3.13	2.10	1.15	146	129	83
Quartile	Medium	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIFI ALL	SAIFI IEEE	SAIFI WOF	CAIDI ALL	CAIDI IEEE	CAIDI WOF
0	MIN	44	30	30	0.45	0.35	0.35	65	65	84
1	Q1	142	100	91	1.13	0.95	0.84	111	95	99
2	MEDIAN	182	124	121	1.25	1.14	1.00	136	111	110
3	Q3	274	152	143	1.57	1.31	1.17	198	122	118
4	MAX	1855	446	437	2.42	2.18	2.08	767	205	
Quartile	Large	SAIDI ALL	SAIDI IEEE	SAIDI WOF	SAIFI ALL	SAIFI IEEE	SAIFI WOF	CAIDI ALL	CAIDI IEEE	CAIDI WOF
0	MIN	69	63	63	0.70	0.56	0.54	81	77	126
1	Q1	120	90	86	1.04	0.91	0.85	117	99	133
2	MEDIAN	190	110	106	1.15	1.00	0.94	140	111	142
3	Q3	248	168	155	1.63	1.28	1.07	171	127	157
4	MAX	703	432	396	3.40	2.45	1.85	304	212	



Source: IEEE Benchmark Year 2017 Report by IEEE PES DRWG

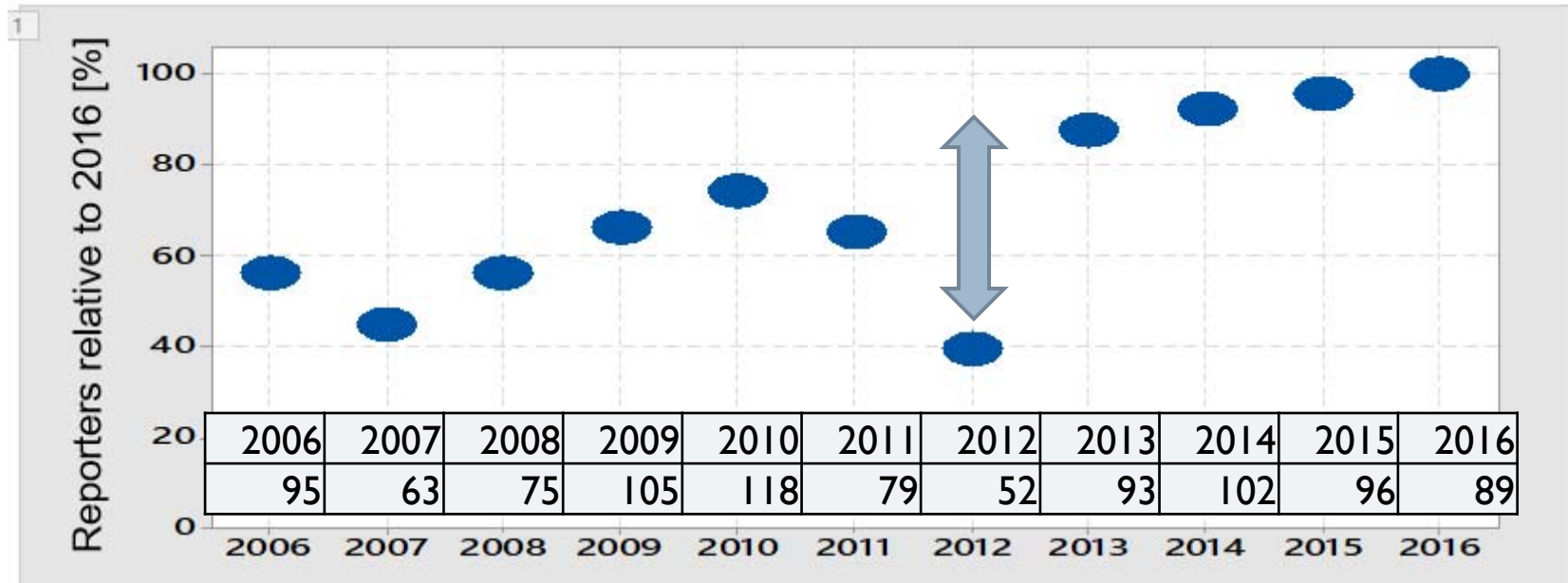
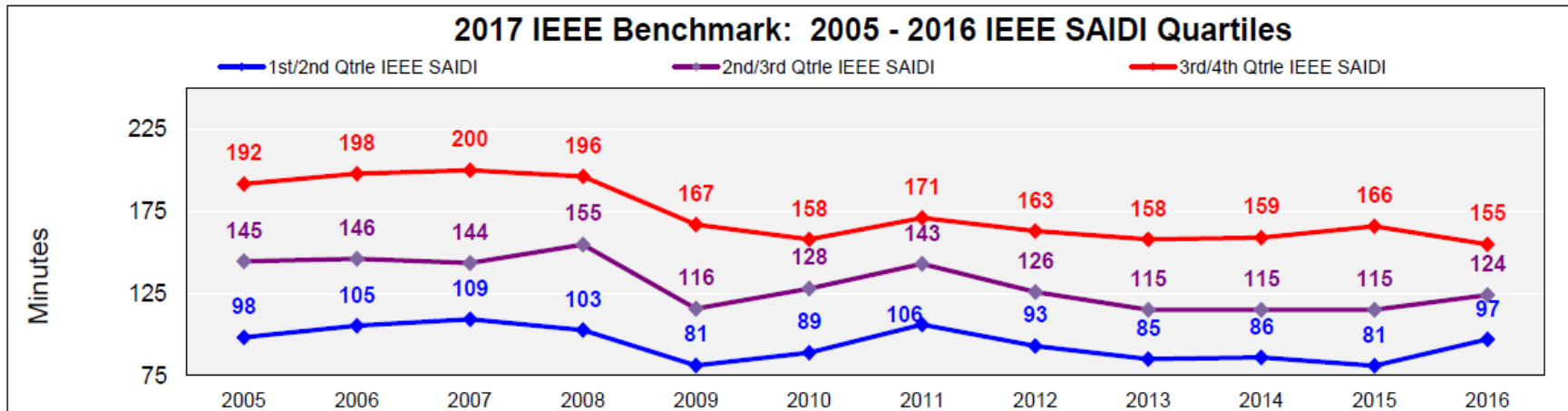
IEEE Information - Overview

- ▶ **All public information**
- ▶ **Data from 2006 to 2016:**
 - ▶ Number of participants ~ 95
 - ▶ Includes region where each utility is located
 - ▶ Provides general statistics (min, max, median, quartiles) for small, medium, and large utilities
- ▶ **Several sets of indices are reported:**
 - ▶ Total (also known as All): everything that customers have experienced
 - ▶ IEEE (also known as Day to Day Performance): excludes major events
 - ▶ WOF: Separate impact of transmission outages (introduced in 2011)
 - ▶ WOP: Separate impact of planned outages (introduced in 2012)

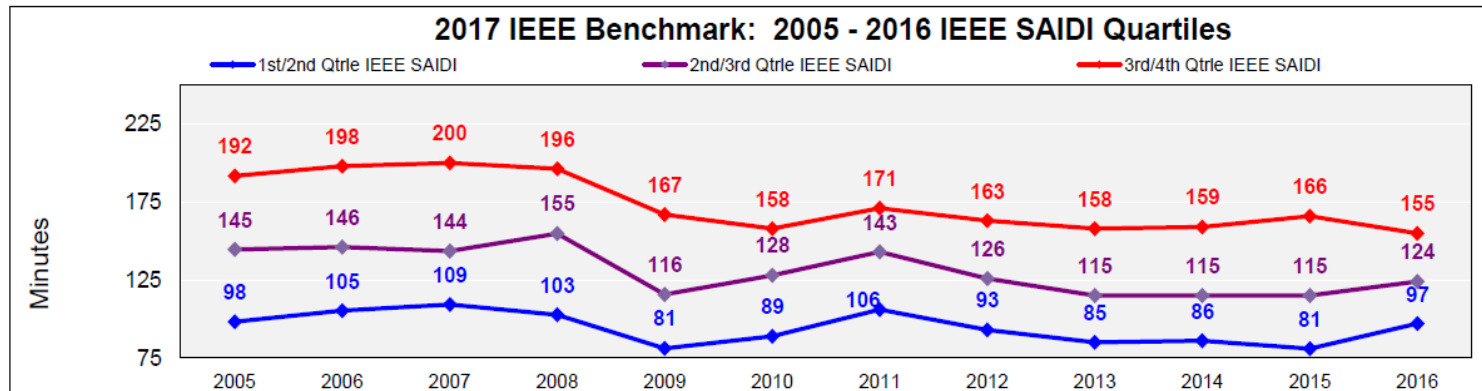
Focused on IEEE Set: Day to day performance

A fresh look at the available data...

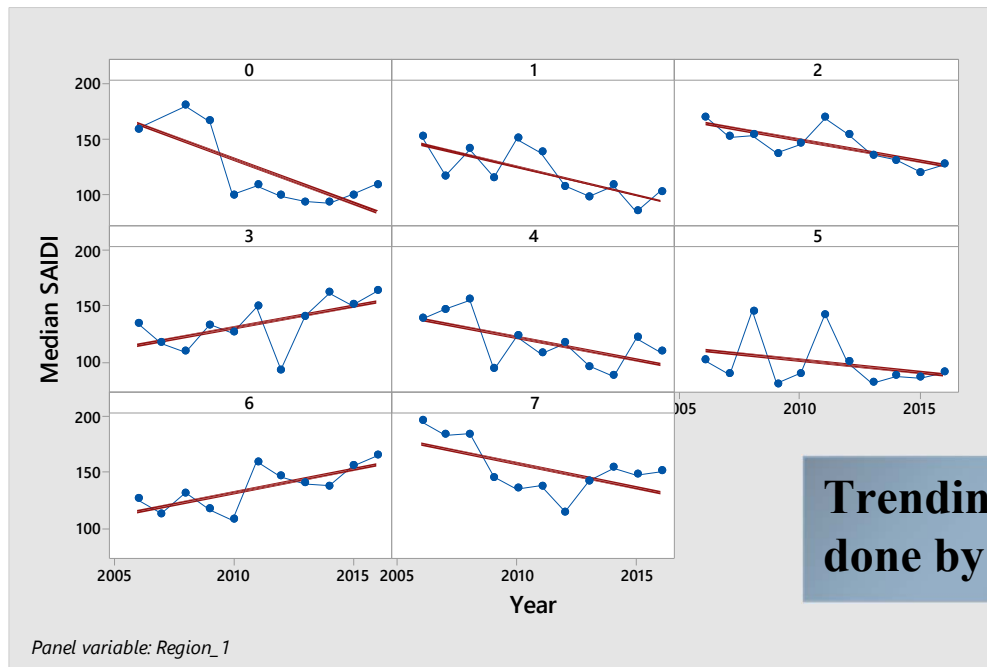
IEEE Data Implications - Consistency



IEEE Data Implications – SAIDI Regionality



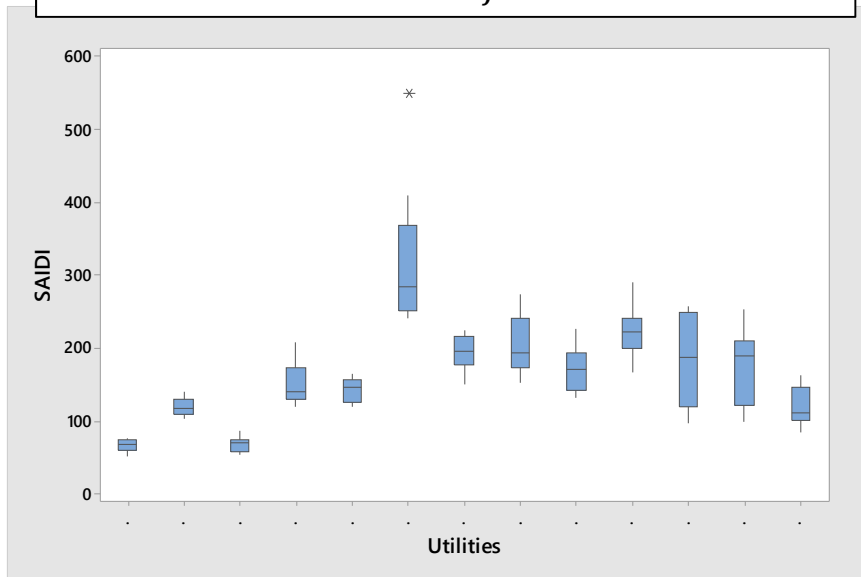
	Region
0	Span States or unknown
1	Northeast
2	Mid-Atlantic
3	Southeast
4	Midwest
5	Southwest
6	South
7	Northwest



Trending can be done by Region

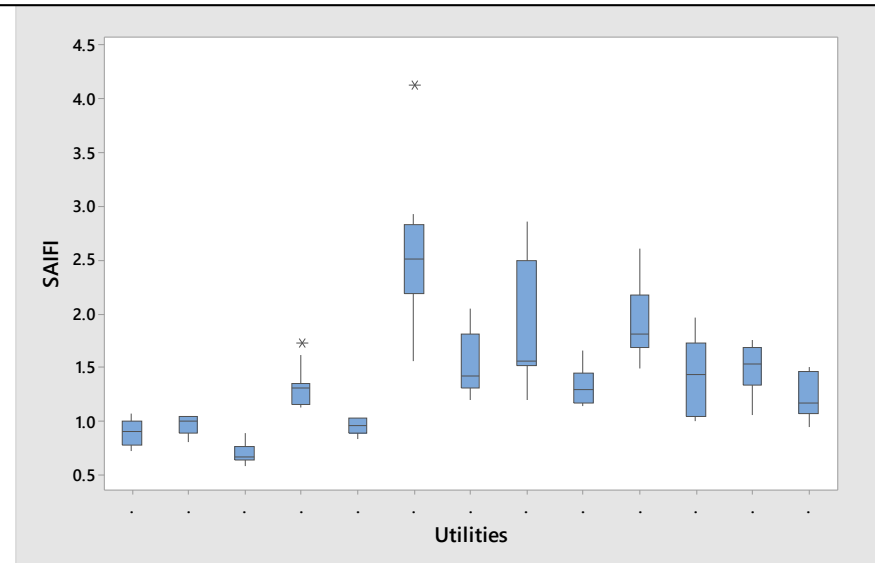
IEEE Consistent Reporters – Performance over time

$$SAIDI = \frac{\sum \text{Customer Minutes of Interruption}}{\text{Total Number of Customers Served}}$$



13 companies have responded all years

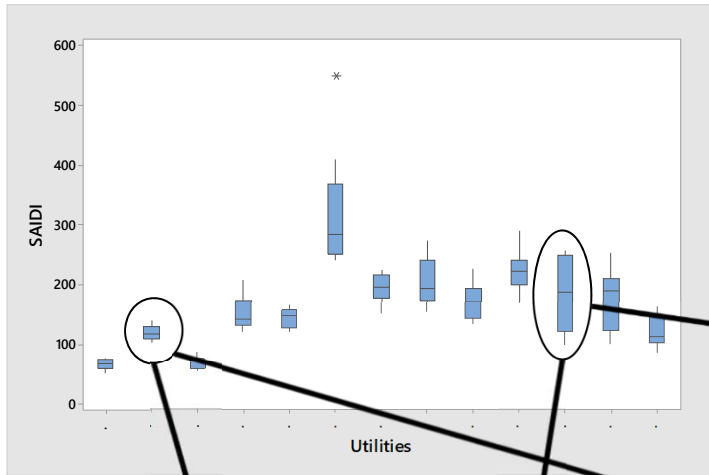
$$SAIFI = \frac{\sum \text{Total Number of Customers Interrupted}}{\text{Total Number of Customers Served}}$$



Some utilities have higher values of SAIDI / SAIFI than others

Some utilities have very narrow ranges over time while others have much more variability over the years

IEEE Consistent Reporters – Reliability Growth



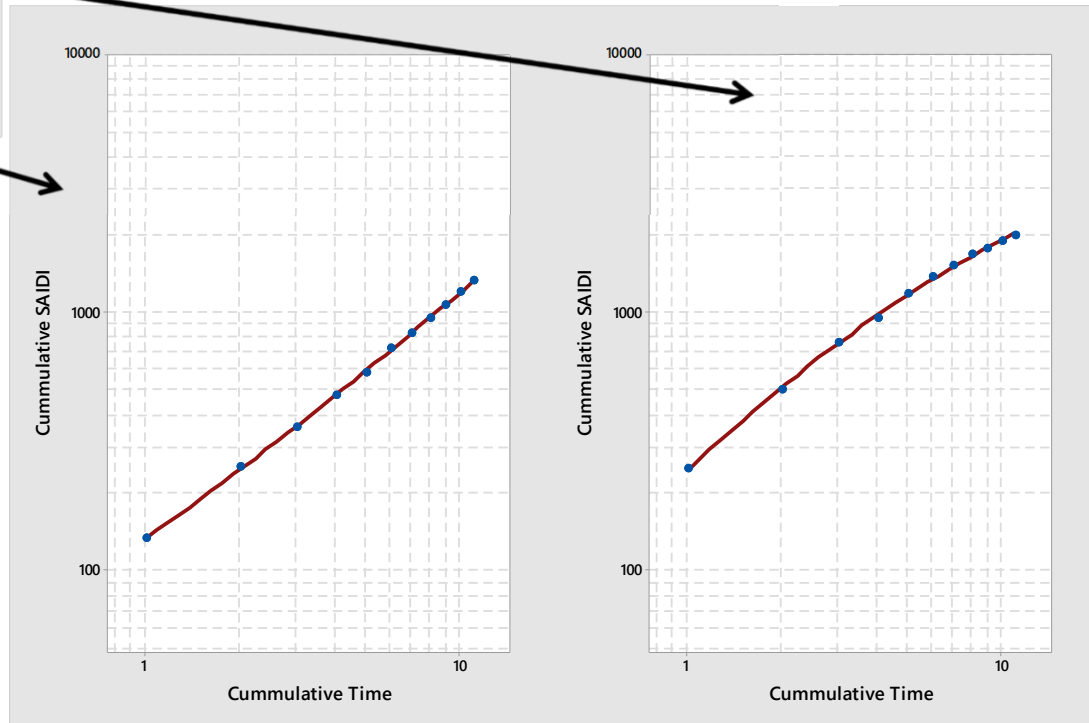
Which utility would you rather be?

The answer is not evident, it requires more in depth analysis

Reliability Growth Model

Lower Median SAIDI and narrower range over the years

Larger Median SAIDI and wider range over the years



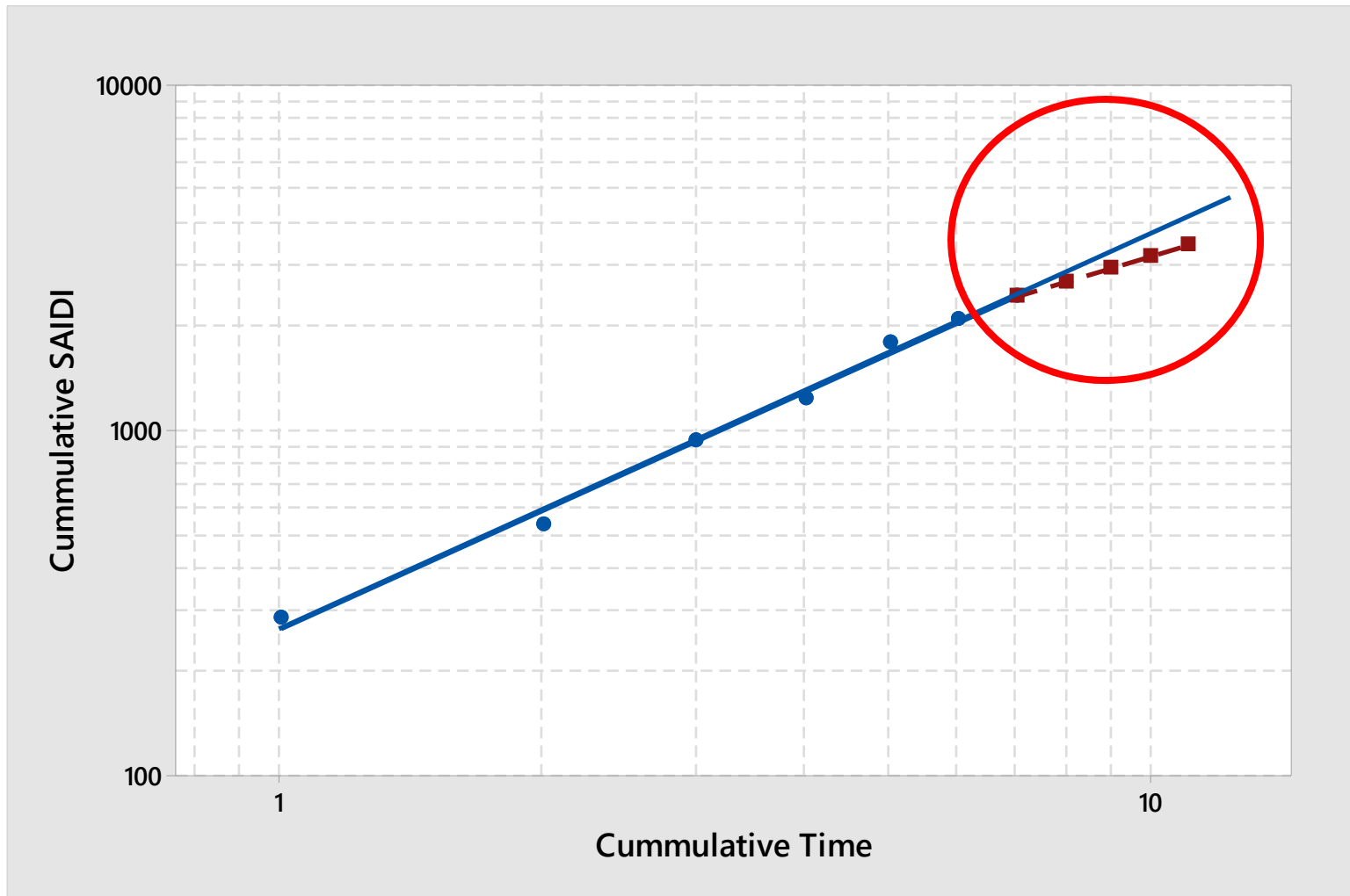
IEEE Consistent Reporters – Summary

Consistent reporters' performance based on SAIDI and SAIFI:

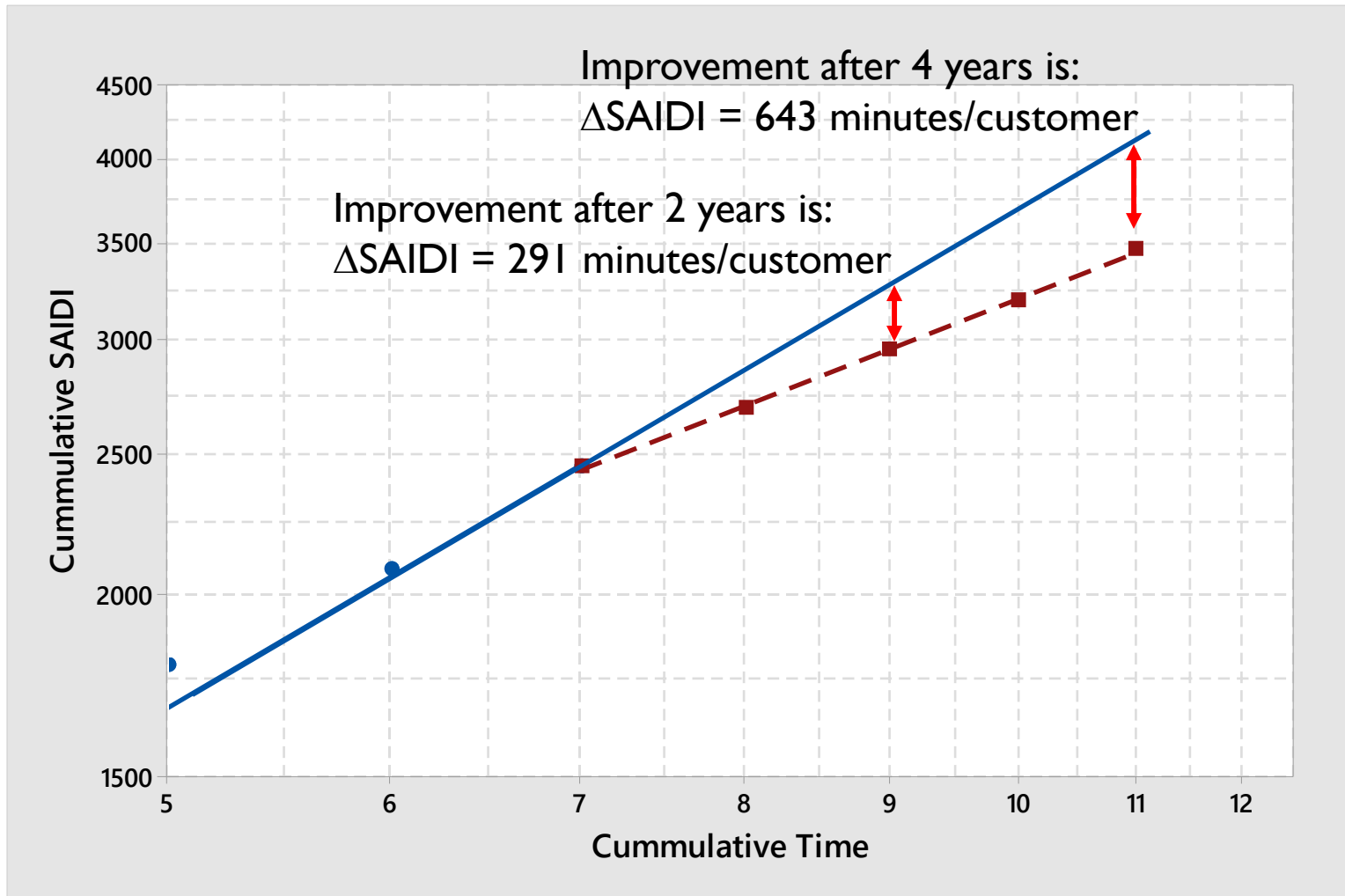
- 6 utilities are improving over time
- 4 utility remain stable
- 3 utilities are experiencing decreased reliability

		SAIDI		
		Going up	Same	Going down
SAIFI	Going up	1	0	0
	Same	2	4	0
	Going down	0	0	6

IEEE Consistent Reporters – Prognosis



IEEE Consistent Reporters – Evaluation



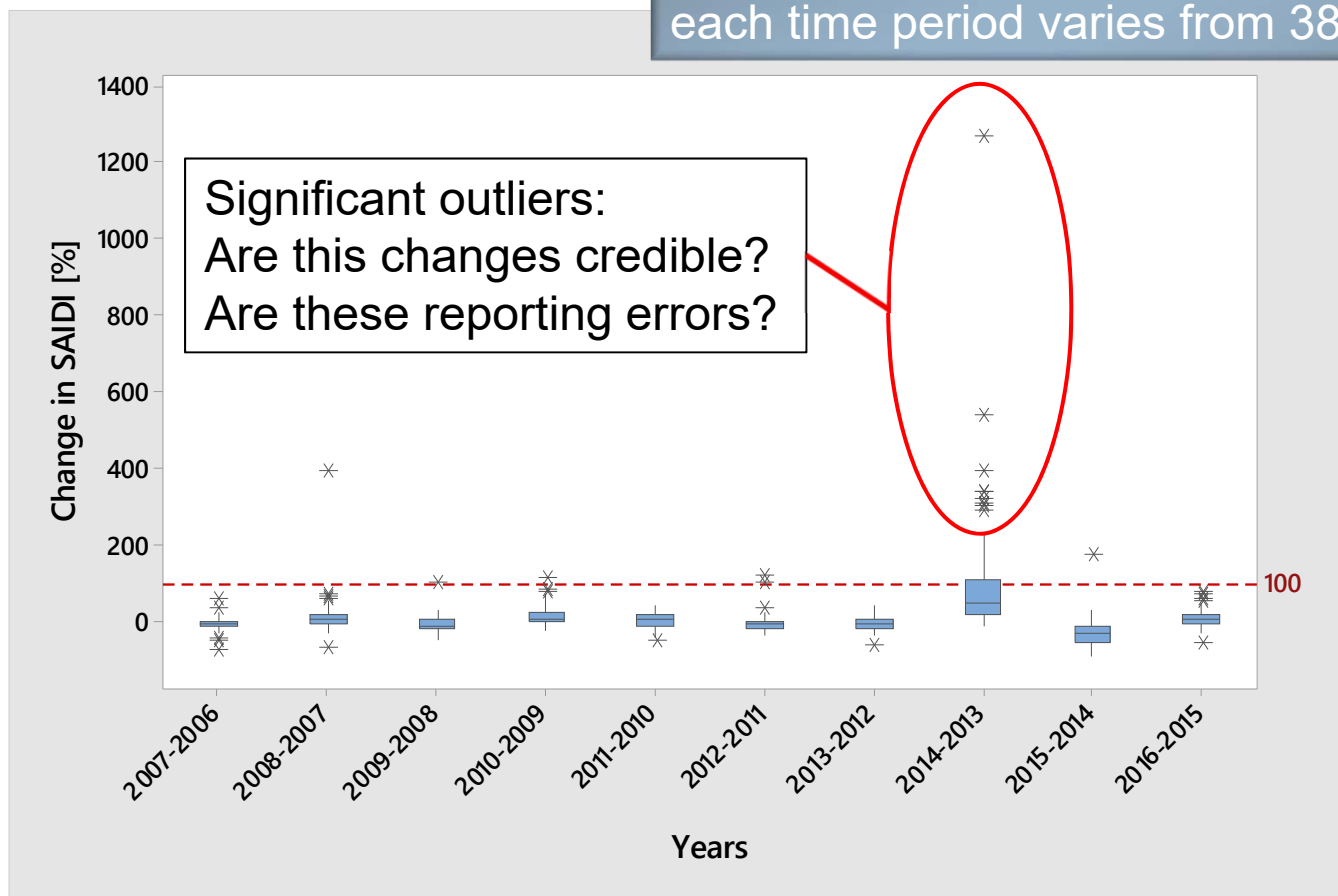
IEEE SAIDI – SAIFI Changes over time

- ▶ **Considering 2006-2016 data:**
 - ▶ 197 companies have responded at some point in time
 - ▶ 86 companies reported at least half of the time (5 years or more)
- ▶ **Remarks based on all companies:**
 - ▶ Significant outliers when computing changes in reliability indices year by year
 - Are these changes credible?
 - Are these outliers due to reporting issues?
 - Errors in transcribing data?
 - ▶ Use Histograms to determine more reasonable bounds for the year by year changes
 - ▶ Map created to identify areas of improved or degraded reliability

IEEE All Companies – SAIDI Changes

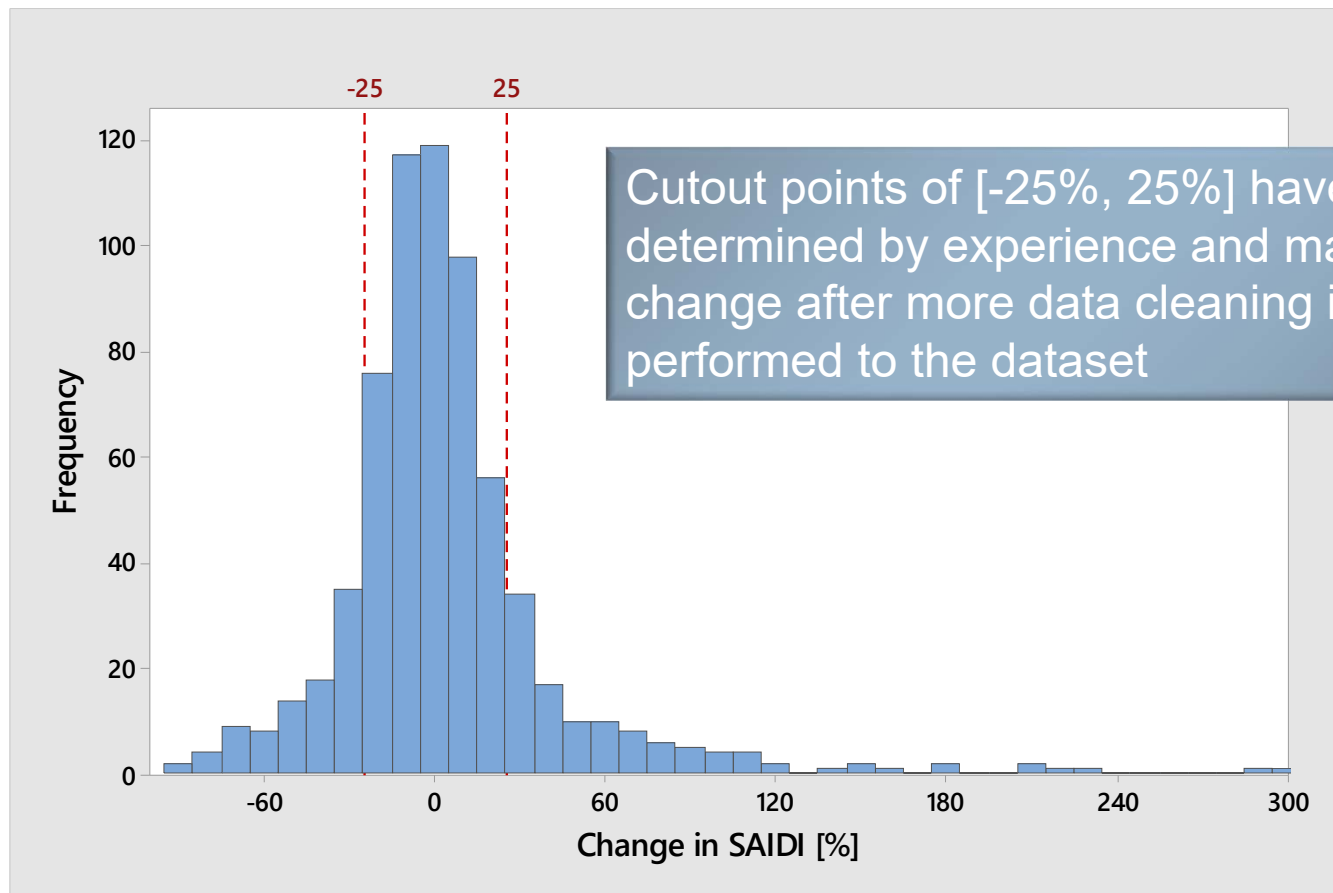
- ▶ Percentage change from one year to another for all utilities reporting in the corresponding two years

The number of companies reporting in each time period varies from 38 to 87



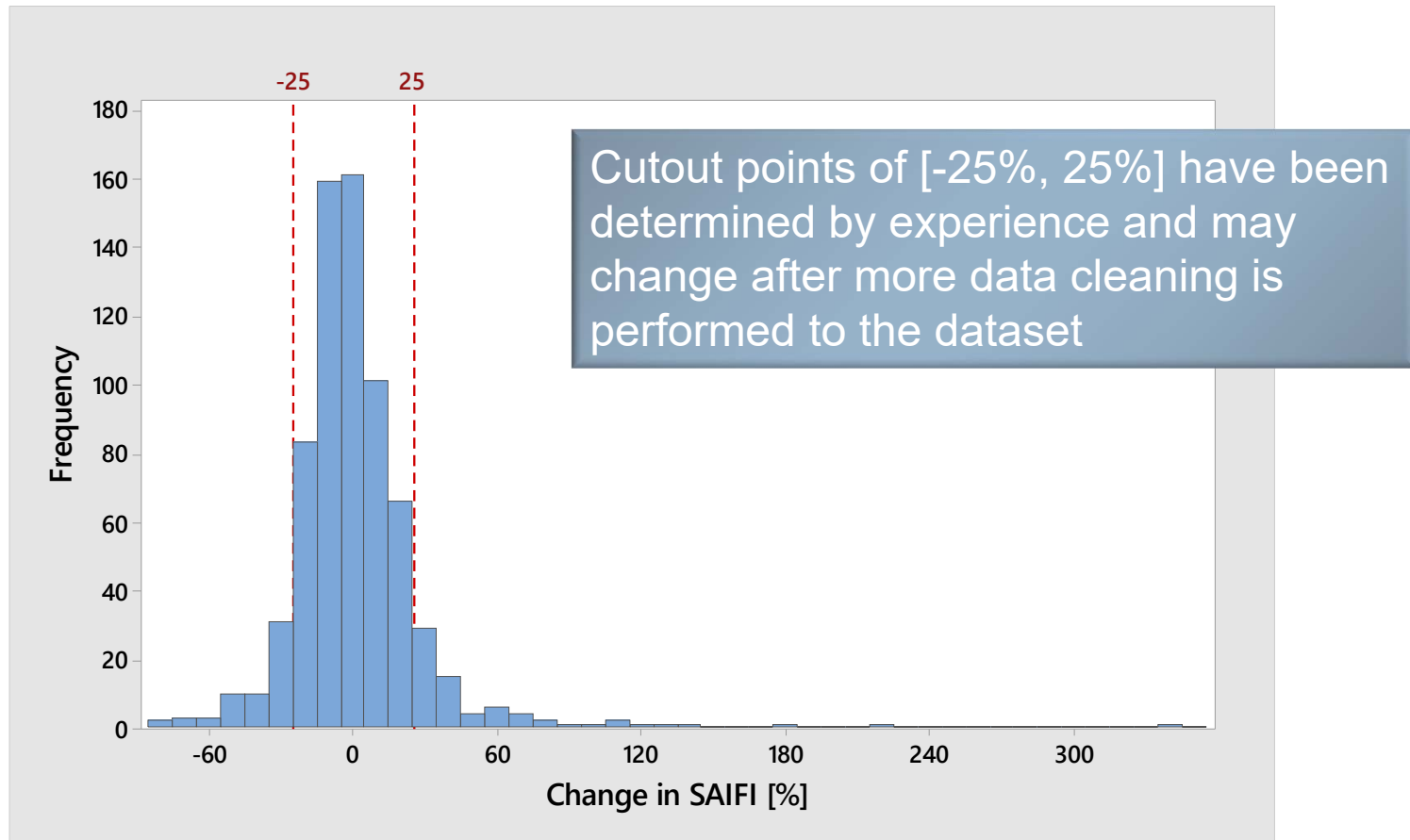
IEEE All Companies – SAIDI Changes Outlier Rejection

- ▶ Suitable range in SAIDI changes seems to be: [-25%, 25%]

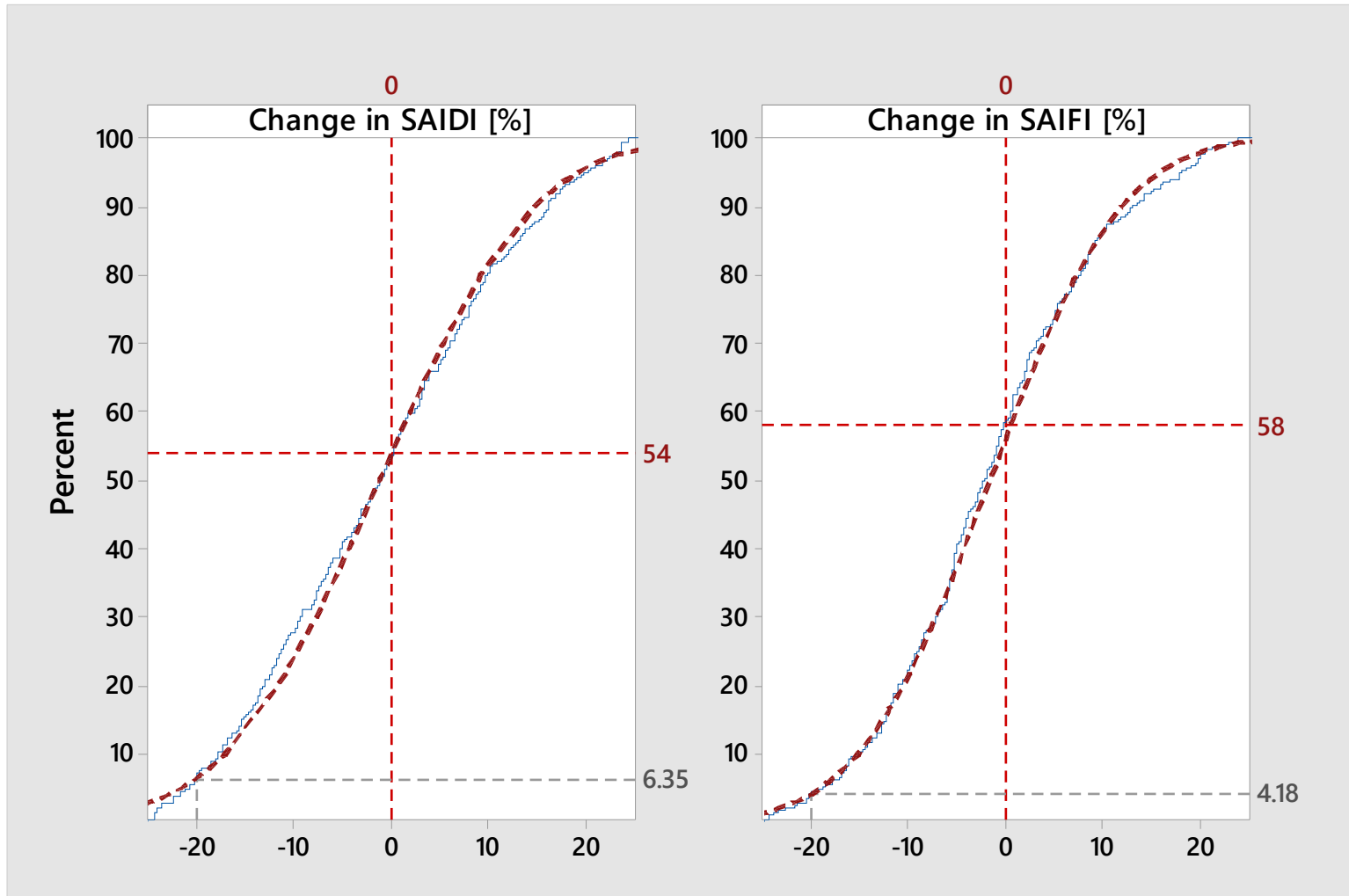


IEEE All Companies – SAIFI Changes Outlier Rejection

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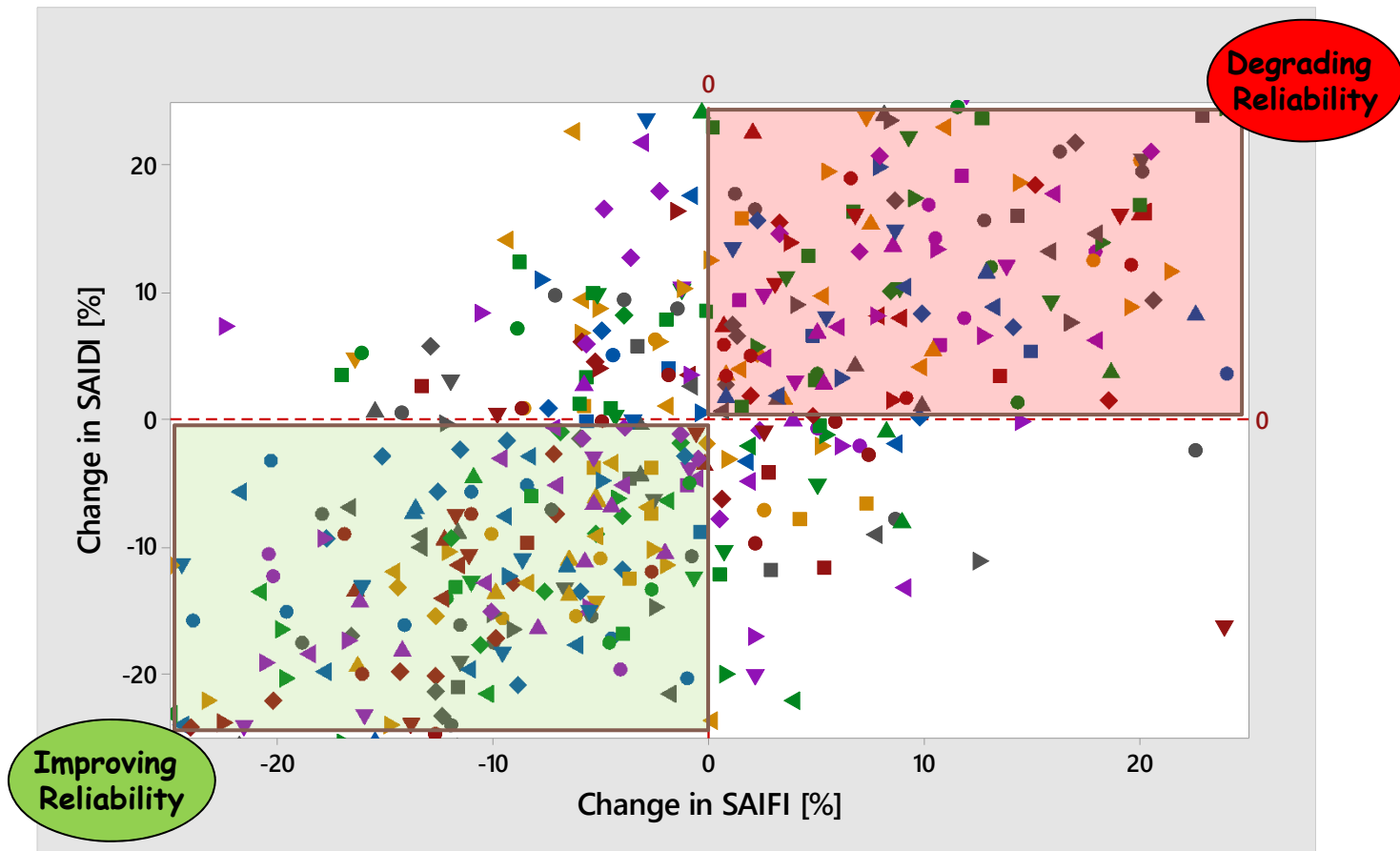


IEEE All Companies – Historic changes

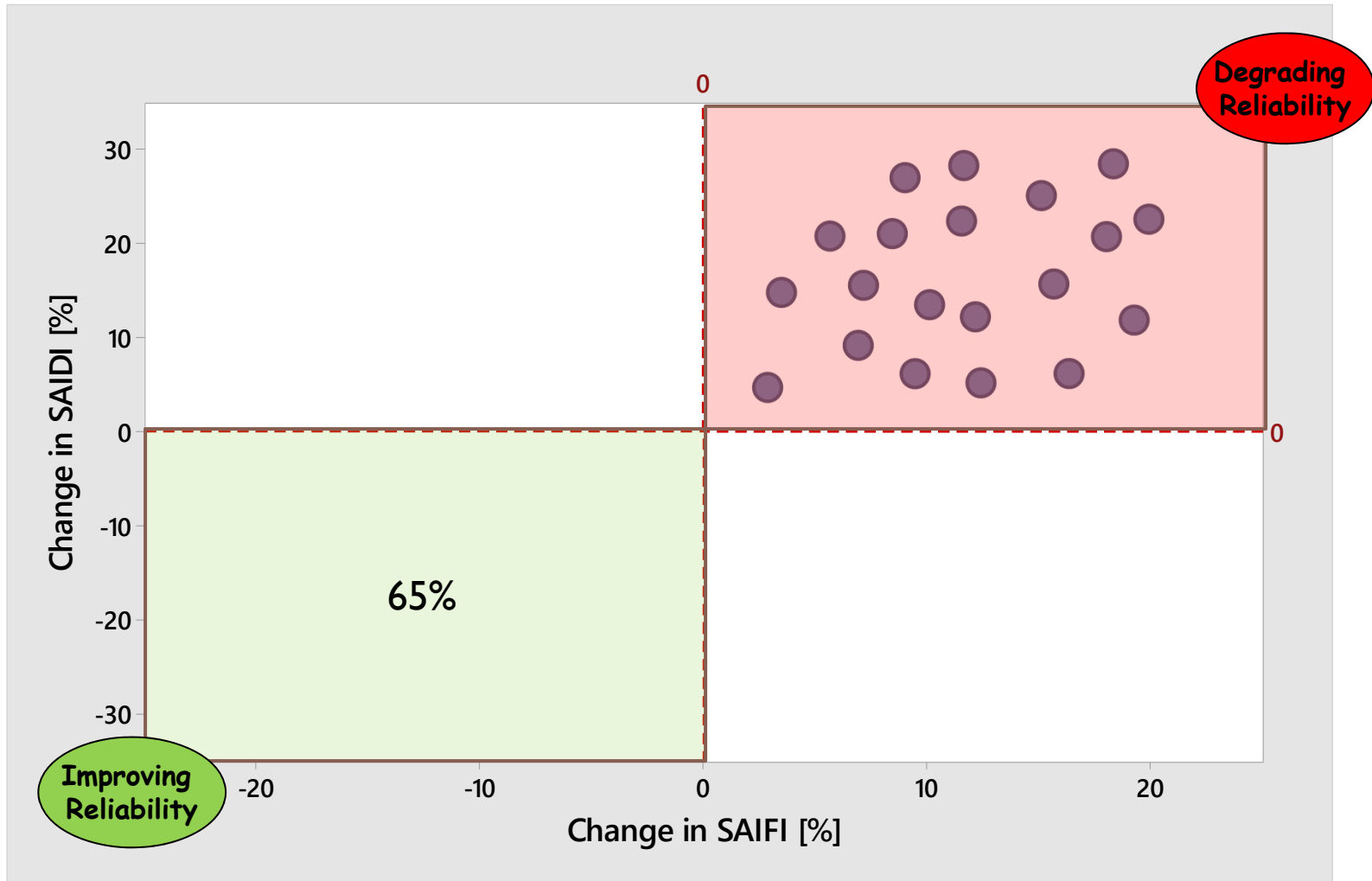


IEEE All Companies – SAIDI vs SAIFI Changes

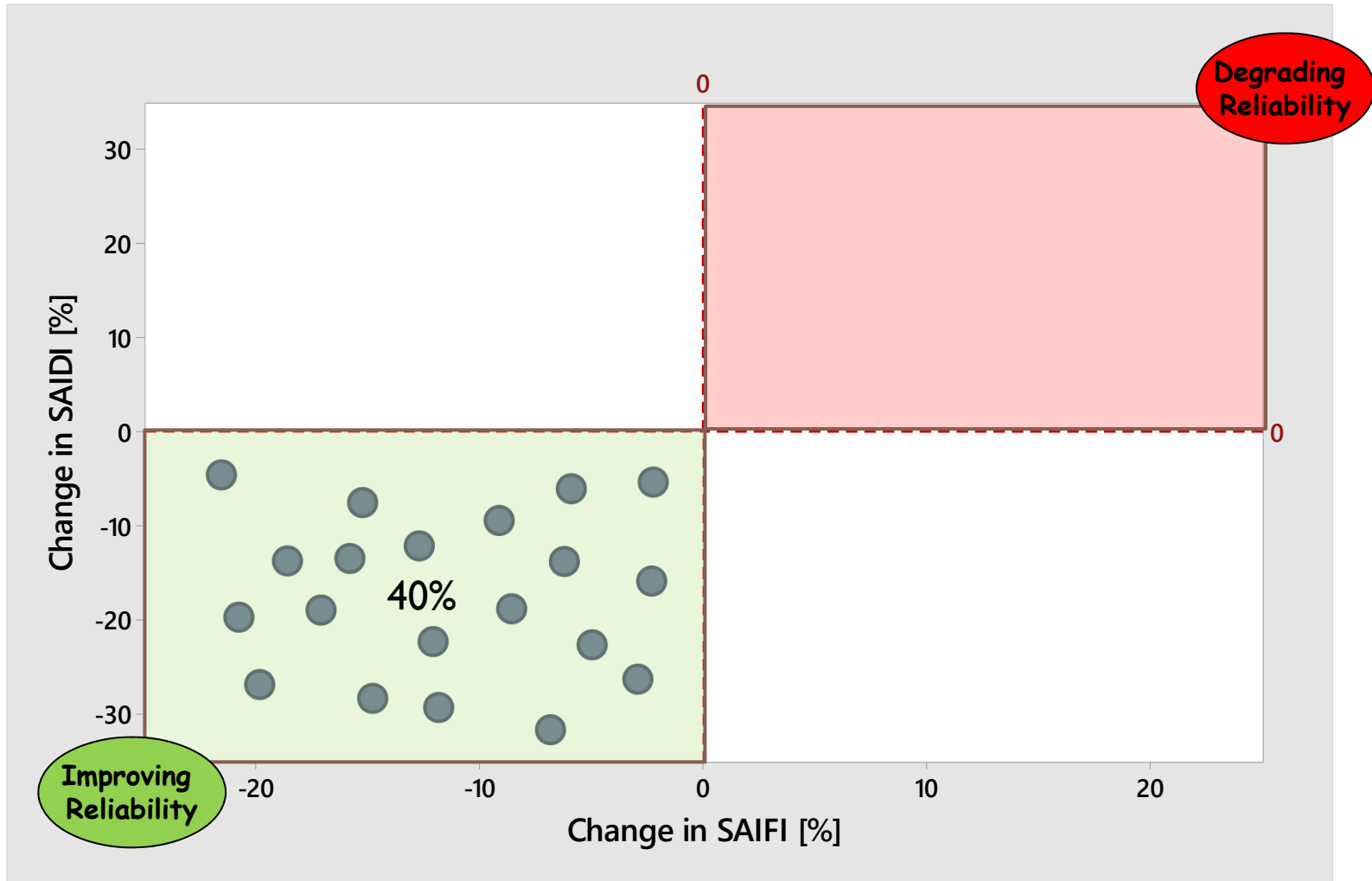
- ▶ Filtered data, each symbol corresponds to a different company



IEEE All Companies - Progression



IEEE All Companies - Progression



**Thank you very
much for your
attention**

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