Adaptive, Responsive and Tailored Designs: A Research Agenda

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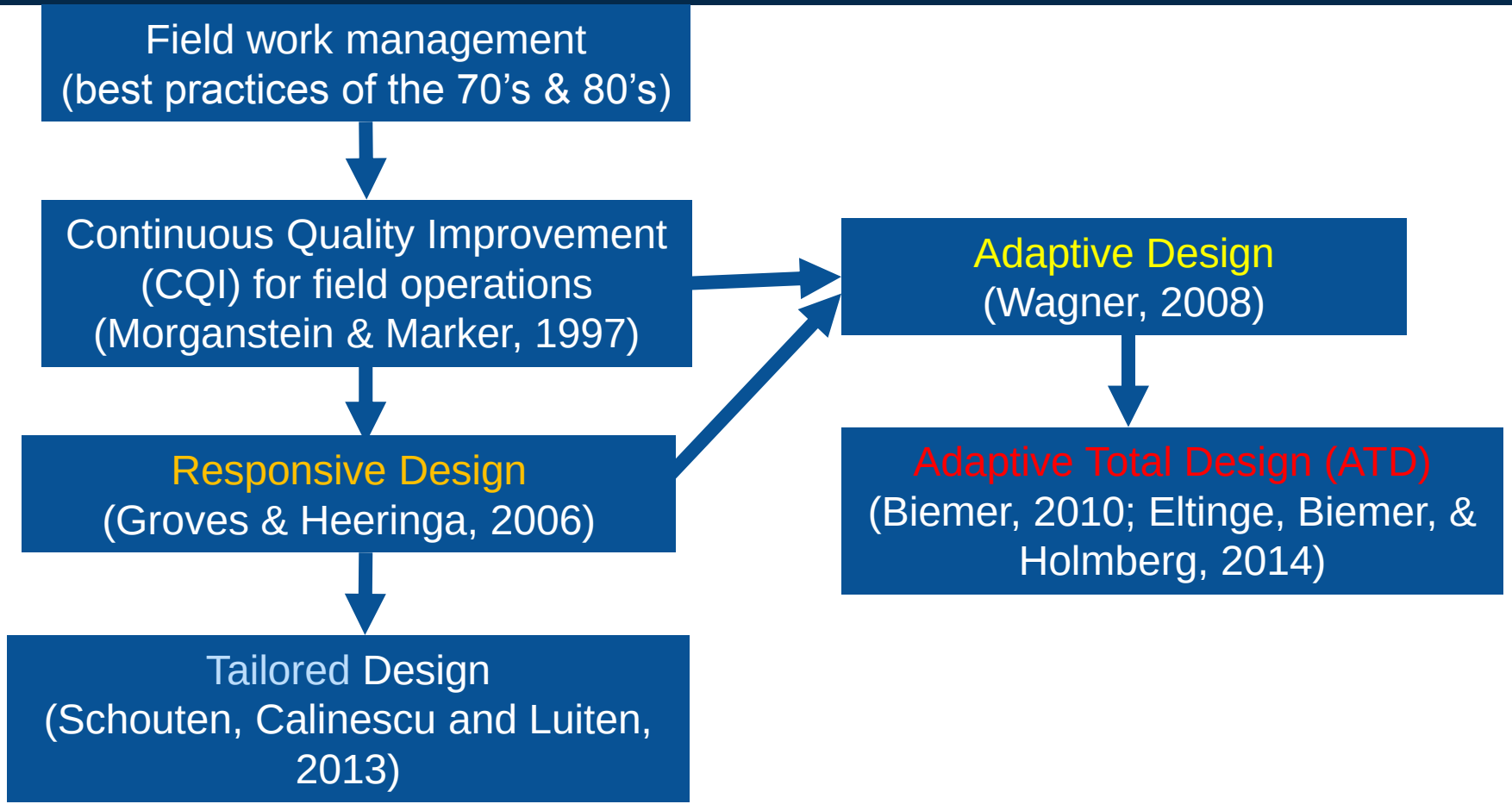
Evolution of Adaptive, Responsive and Tailored Designs



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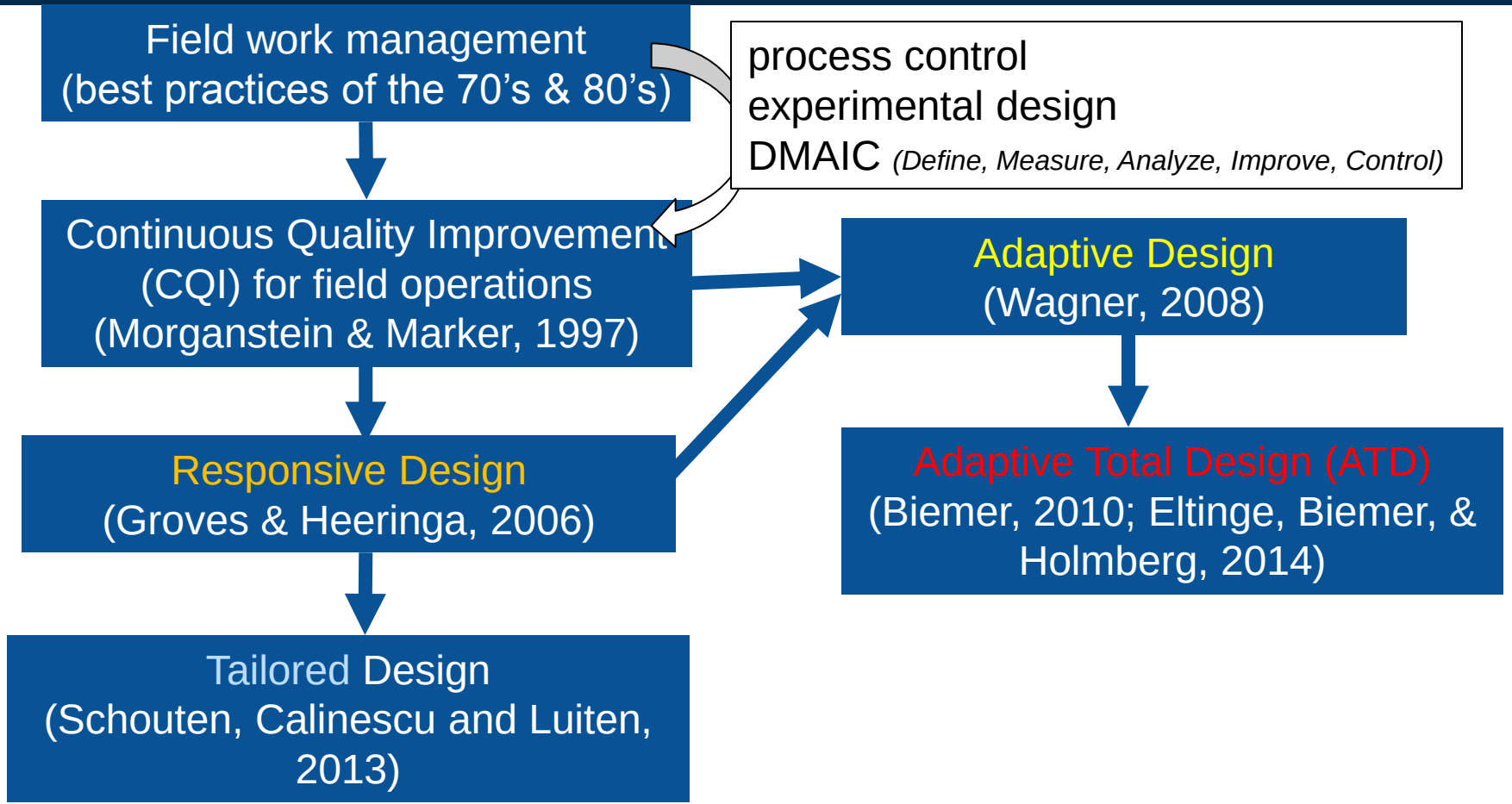

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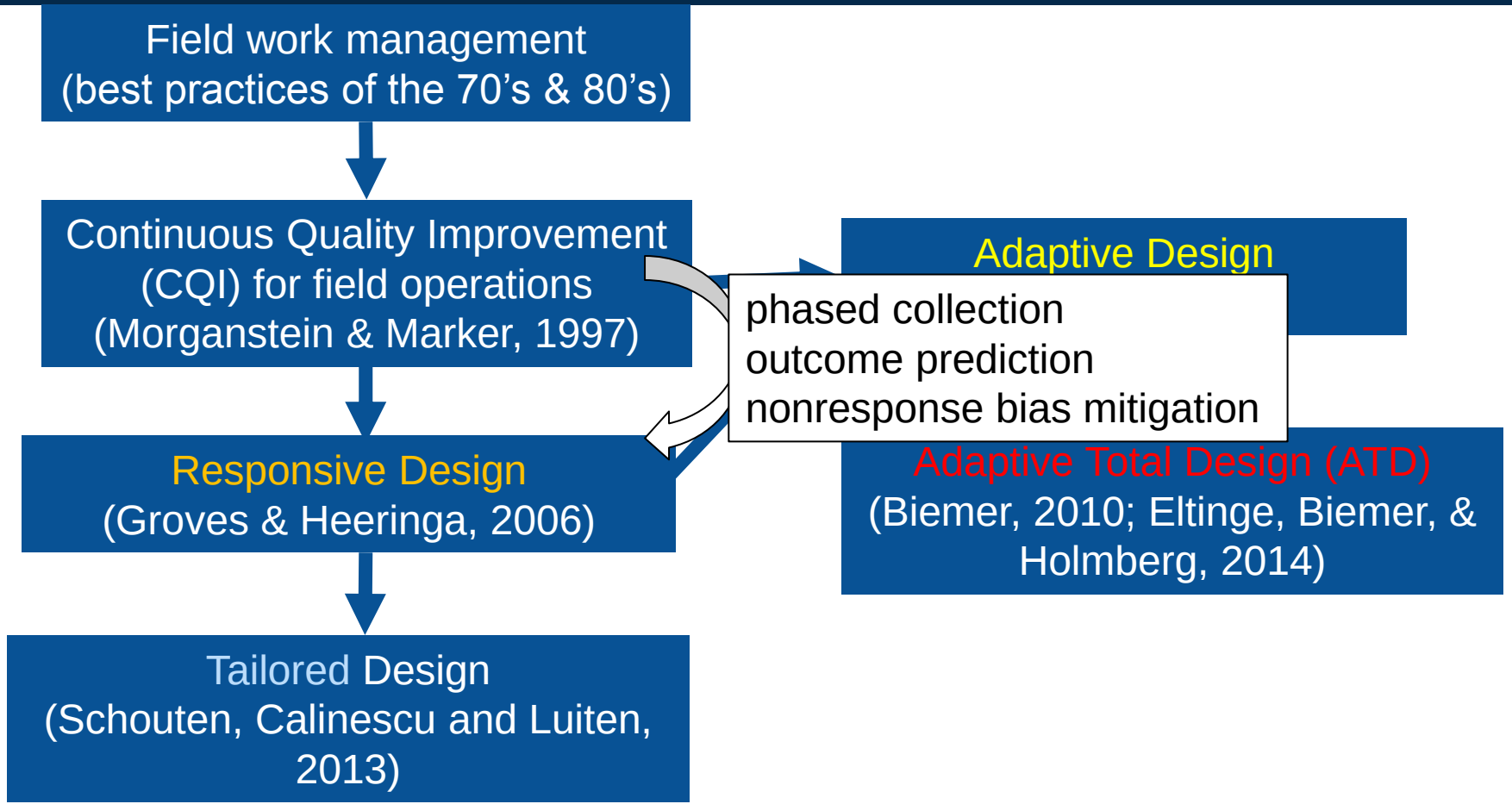

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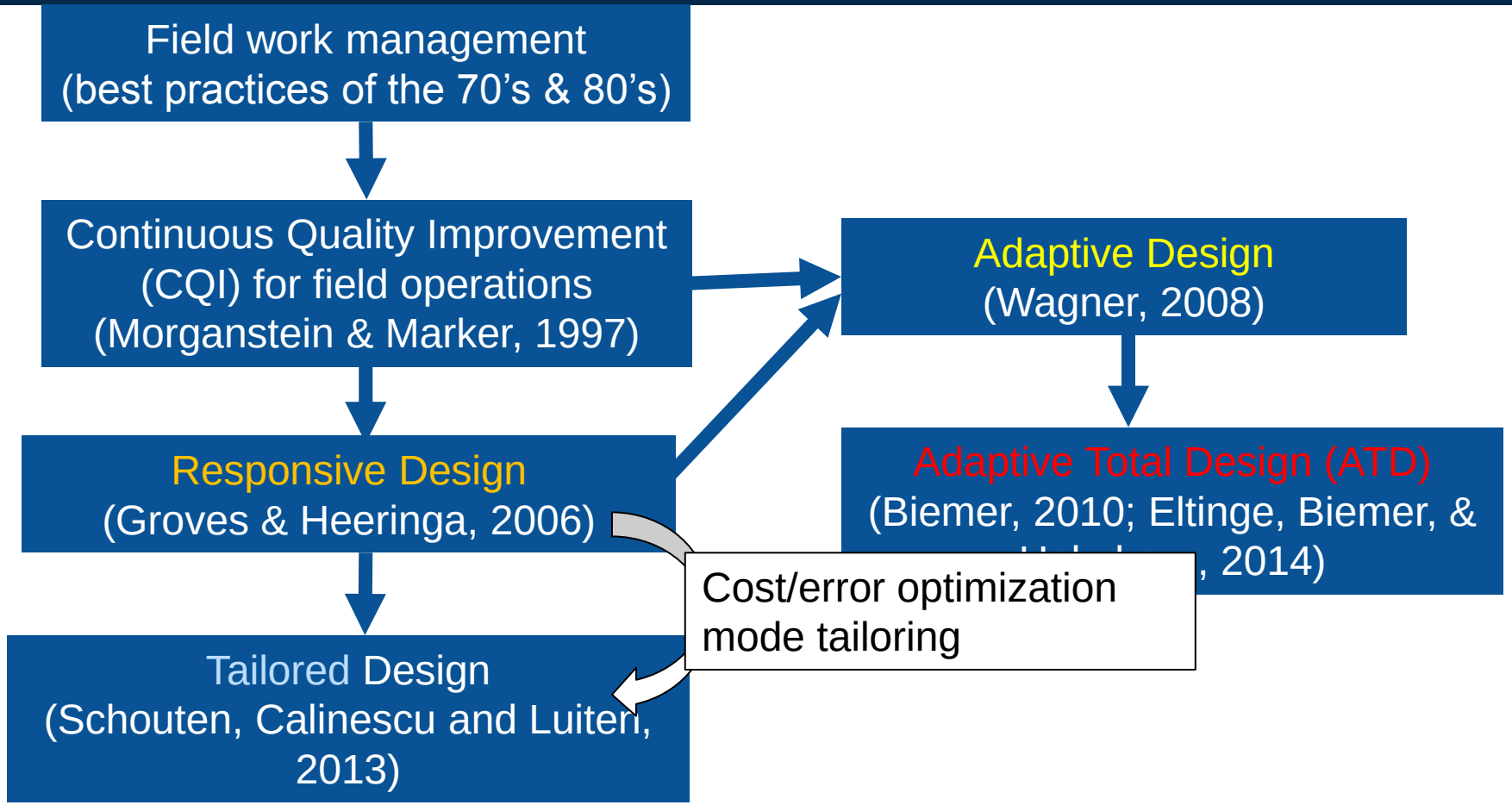

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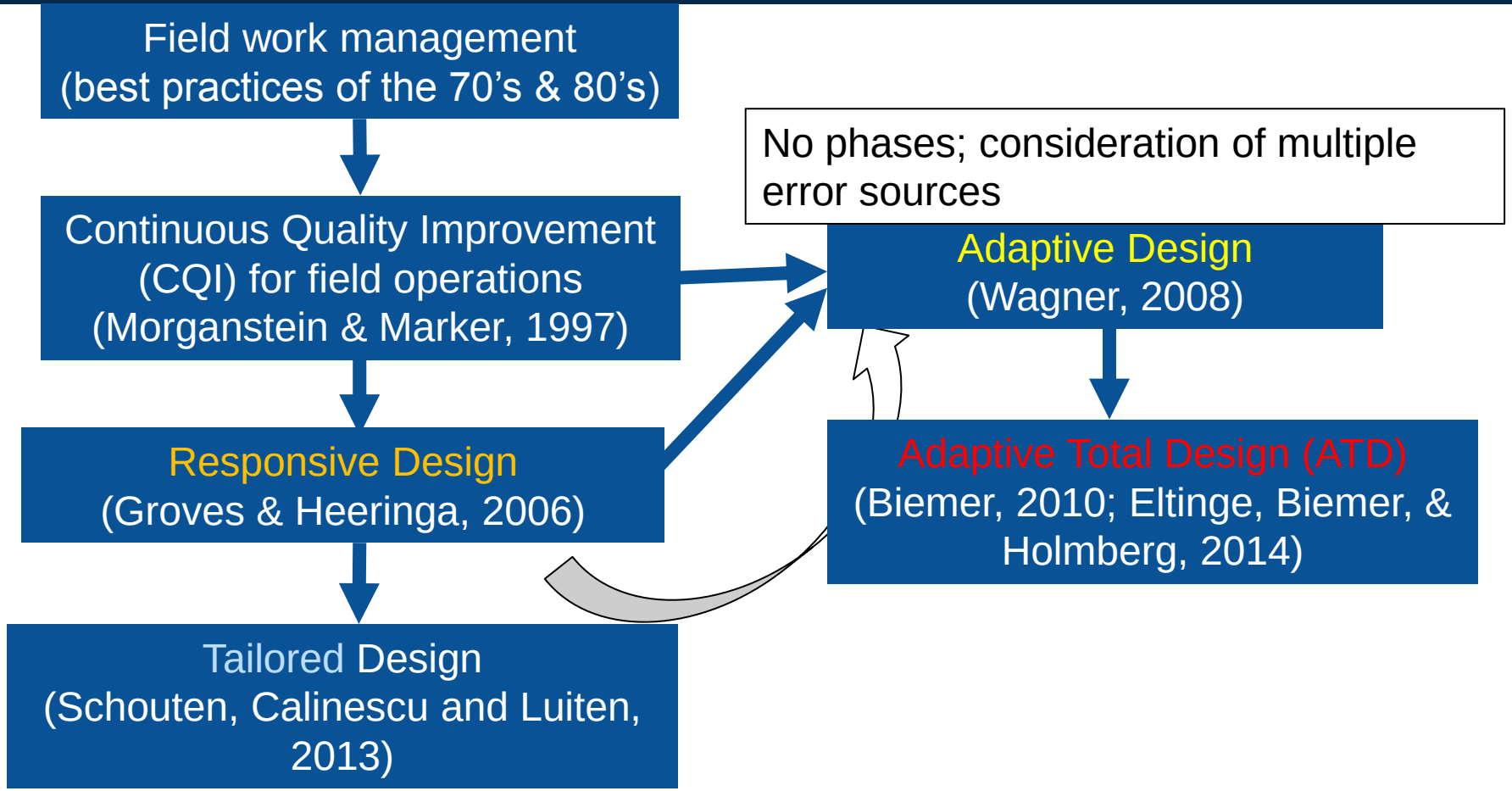

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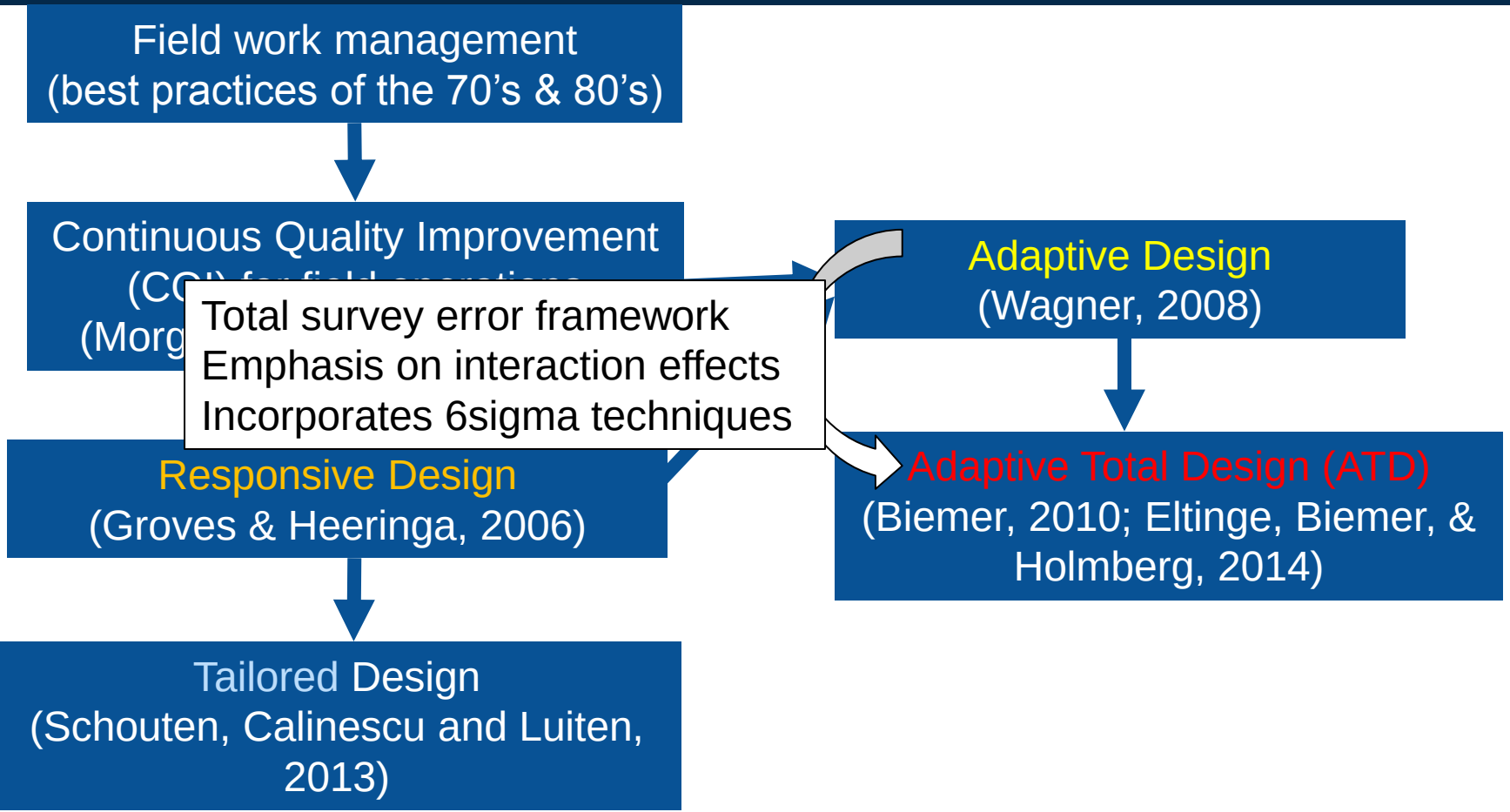


Key Differences between these Data Collection Approaches

Defining Feature	Responsive	Tailored	Adaptive	ATD
Real time data/paradata monitoring	✓	✓	✓	✓
Incorporates an experimental phase	✓	✓		
Predicts survey outcomes	✓	✓	✓	✓
Minimization of nonresponse error	✓		✓	
Phase capacity triggers intervention	✓			
Data collection protocol tailored to subgroup to minimize cost/error		✓		
Monitors multiple error sources	✓	✓	✓	✓
Monitors all major error sources				✓
Monitors interaction effects across error sources				✓
Distinguishes between common and special cause variation				✓

Major research streams across approaches

1. Contact/response propensity modeling
2. Sample balancing
3. Response rate maximization
4. Metric visualization (dashboards, etc)
5. Bias and bias *risk* indicators
6. Real-time interventions to improve data quality
7. Total error monitoring in real time
8. Post-survey statistical adjustments

1. Contact/response propensity modeling – $\rho|\boldsymbol{X}$

- Estimation
  - Which propensity? Initial, final, contact, cooperation?
  - Estimating $\rho|\boldsymbol{X}$ prior to data collection: $\rho|\boldsymbol{X}_{old}$
  - Updating these estimates during data collection: $\alpha\rho|\boldsymbol{X}_{new} + (1-\alpha)\rho|\boldsymbol{X}_{old}$
  - Use of Bayesian methods for longitudinal surveys (Durrant, et al, 2017)
- Applications
  - Suppose we knew ρ's exactly. How might the survey implementation strategy change to take advantage of this information?
    - E.g.,model-guided field collection protocols (Biemer, et al 2017)
    - Model-aided sampling (Berzofsky, et al, 2010)
  - Balancing ρ's under restricted budgets
  - What methods are most effective for manipulating ρ's for subgroups?

2. Sample balancing

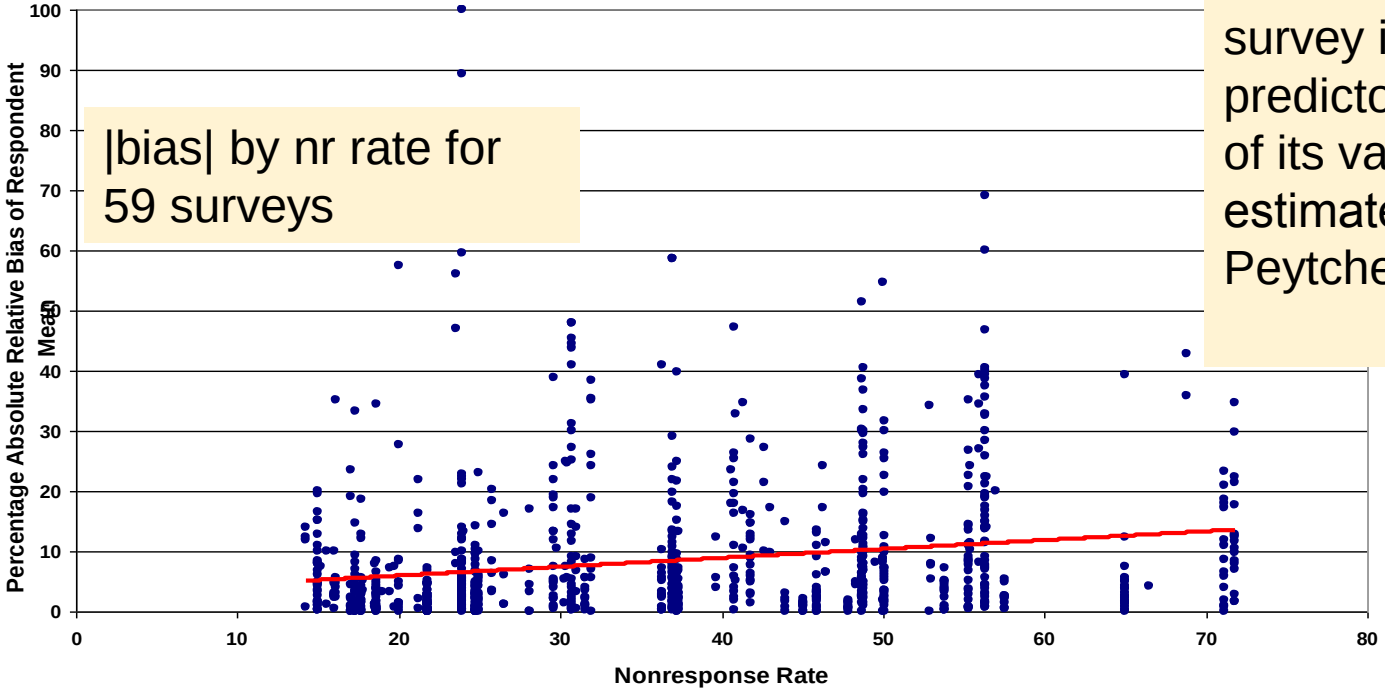
- Benefits of sample balancing
  - Some evidence that balancing on **X** during data collection improves MSE after weighting by **X** (Schouten, et al, 2015; Sarndal and Lundquist, 2017)
- Representativity vs high RR (Lundquist & Särndal, 2013)
  - Bias can increase as response rate increases if $\left|\bar{Y}_R - \bar{Y}_{NR}\right|$ also increases
  - Bias can increase as representativity on X increases if RR decreases
- Optimal selection of **X** for balancing
  - Is the best choice of **X** is one that maximizes Corr(X,Y)?
  - What is the best strategy for omnibus surveys? and longitudinal surveys?
- Balancing $\rho|\mathbf{X}$ versus minimizing: $\left|\hat{\mathbf{X}}_S - \mathbf{X}_P\right|$ When to use each?

3. Response rate maximization

- Why maximize response rate?
  - Groves-Peytcheva data showed the nonresponse is a poor predictor of nonresponse bias.
  - However, it may be a good predictor of nonresponse bias risk
- How to maximize response rate?
  - Traditional means
    - more contact attempts, incentives, more effective interviewing methods, mode changes
  - Two-phase sampling
    - Provides an affordable strategy for increasing response rates
  - Selective matched cases substitution
    - Greater potential for reducing nonresponse bias

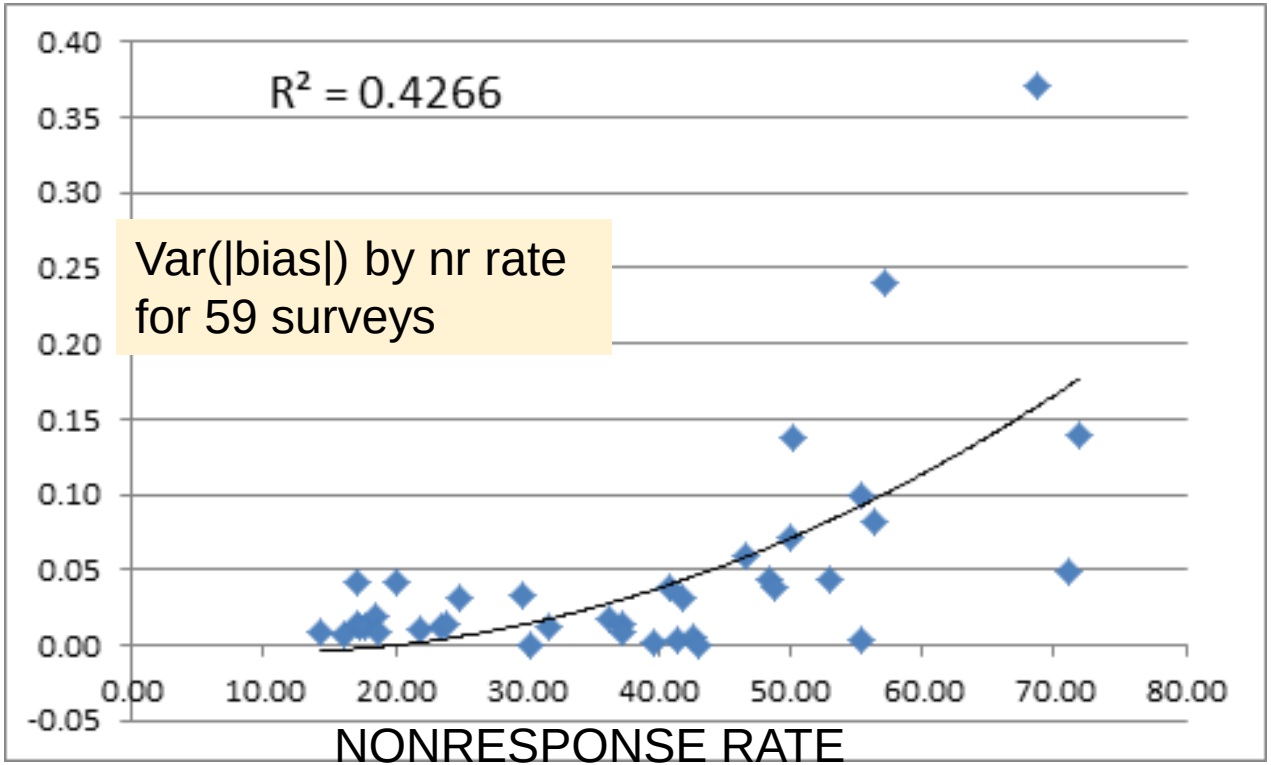
What does the response rate indicate?

"The nonresponse rate of a survey is a poor predictor of the bias of its various estimates" (Groves & Peytcheva, 2006)



"The NR rate of a survey is a poor predictor of the bias of its various estimates" (Groves & Peytcheva, 2006)

Re-analysis: higher NR rate → greater chance some items will have unacceptable NR biases.



Var(|bias|) by nr rate for 59 surveys

The NR rate may be a good predictor of the ***risk*** of NR bias.

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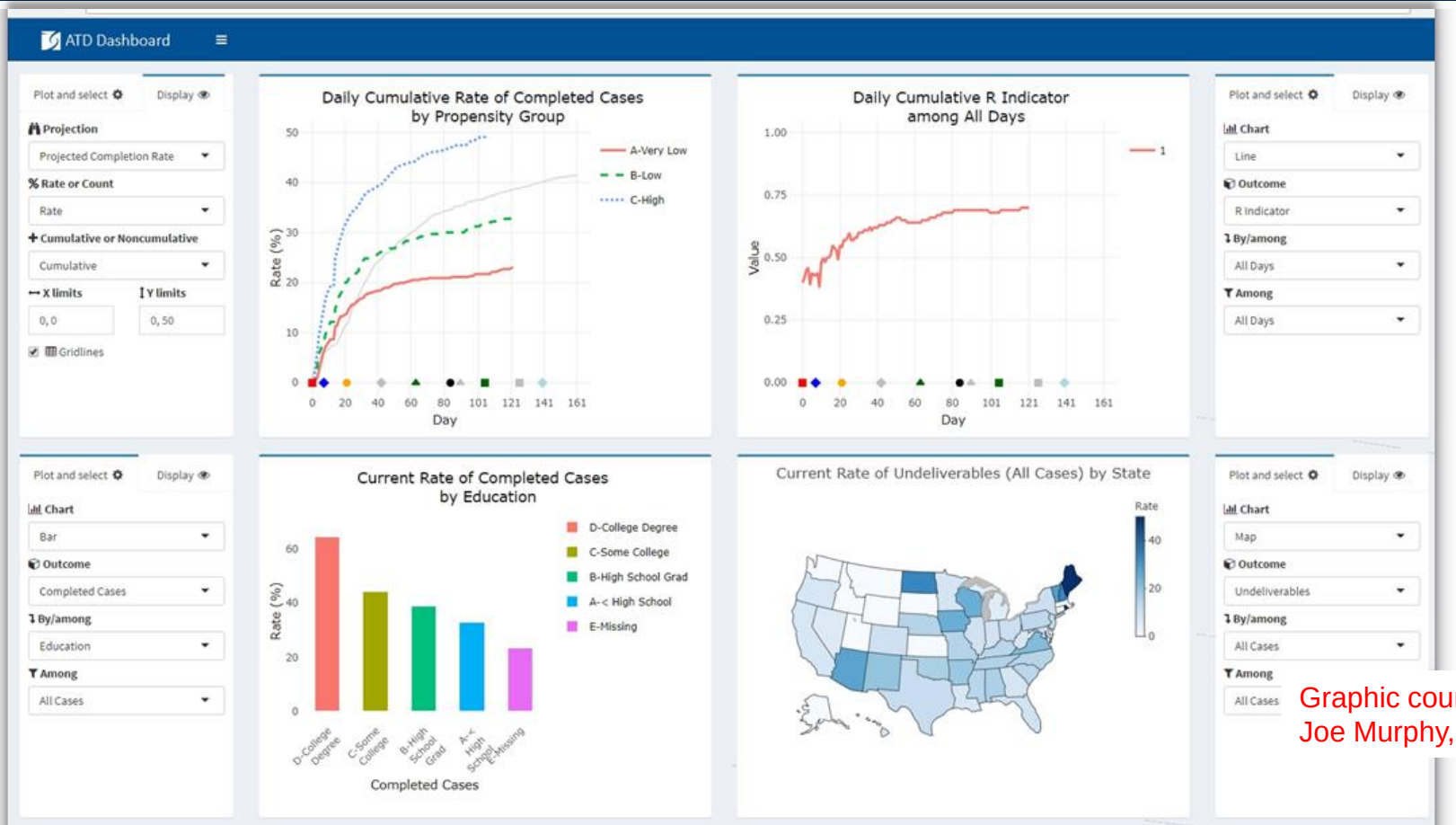
4. Metric visualization



Graphic courtesy of Joe Murphy, RTI

Metric visualization – Some Issues for Research

- Bellwethers of *output* data quality
  - Sample representativity metrics
  - Indicators of residual (post-weighting) nonresponse bias
  - Indicators of measurement error – e.g., interviewer performance via CARI
- The quality of paradata
  - Problems with level of effort data is well-documented
  - Error in response rate projections
- Methods for interpreting temporal variation in quality metrics
  - Use of process control charts to distinguish between common and special cause variation
  - Multi-dimensional metrics (e.g., inter-related dashboard gauges)

5. Bias and bias *risk* indicators

- Response rate
- R-indicator (Schouten, Cobben & Bethlehem, 2009)
- Balance indicators (Sarndal, 2011)
- Mahalonobis distance (Seastrom, 2016)
- Bias effect size (Biemer & Peytchev, 2015)

The Bias Effect Size (BES) Metric

Useful for post-survey NR bias analysis

Requires information on the survey variables for the nonrespondents

Let $\bar{y}_R$ denote the mean of the respondents

Let $\bar{y}_{NR}$ denote the mean of the nonrespondents

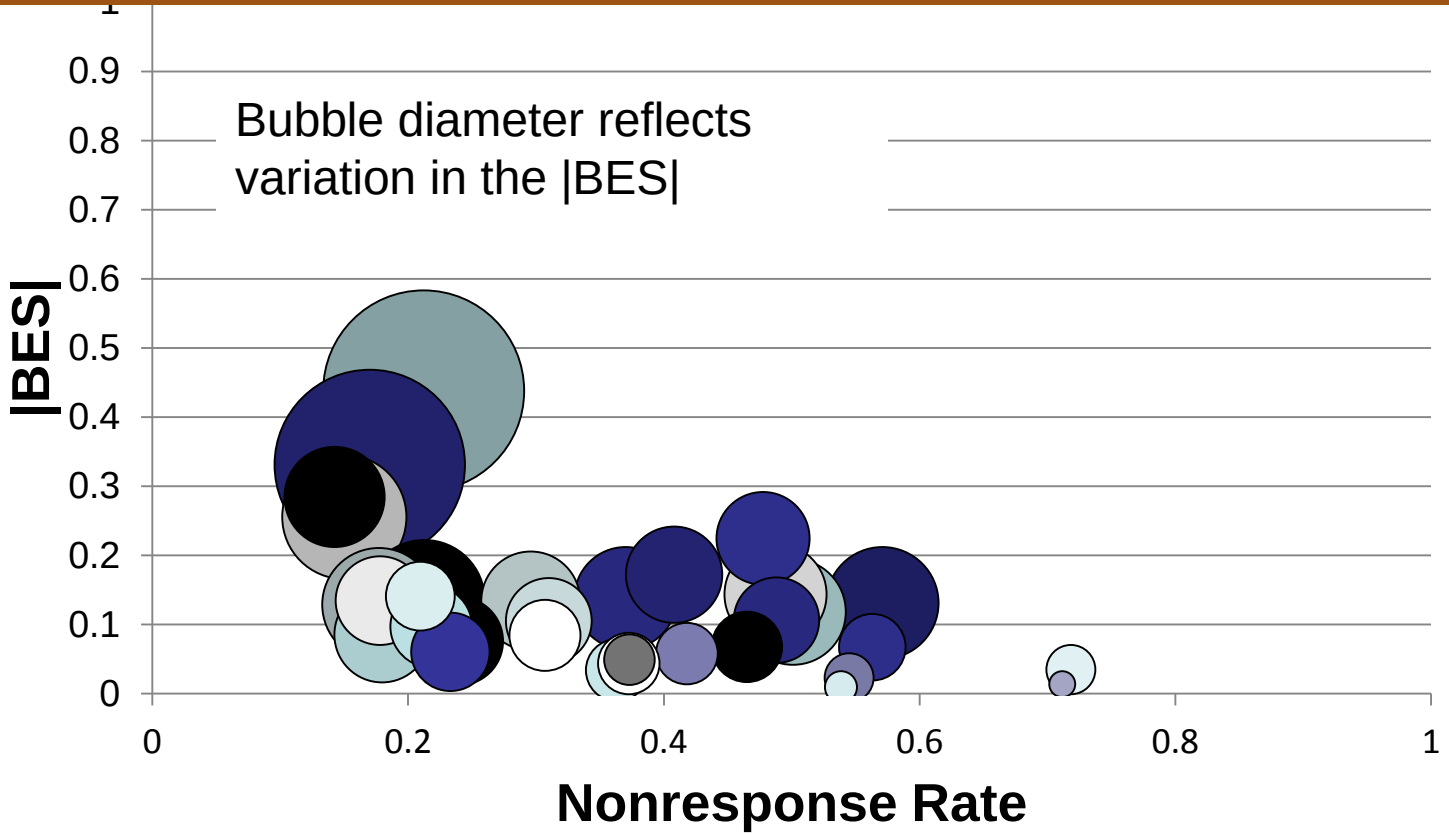
NR bias effect size: $$\text{BES} = \frac{\bar{y}_R - \bar{y}_{NR}}{\text{std.dev.}(y)}$$

Cohen's rule of thumb for effect sizes:

Size of effect	|BES|
Small	.2
Medium	.5
Large	.8

Absolute Bias Effect Size (BES) by Nonresponse Rates

Re-analysis of Groves & Peytcheva (2008) Data



Peytchev & Biemer, 2010

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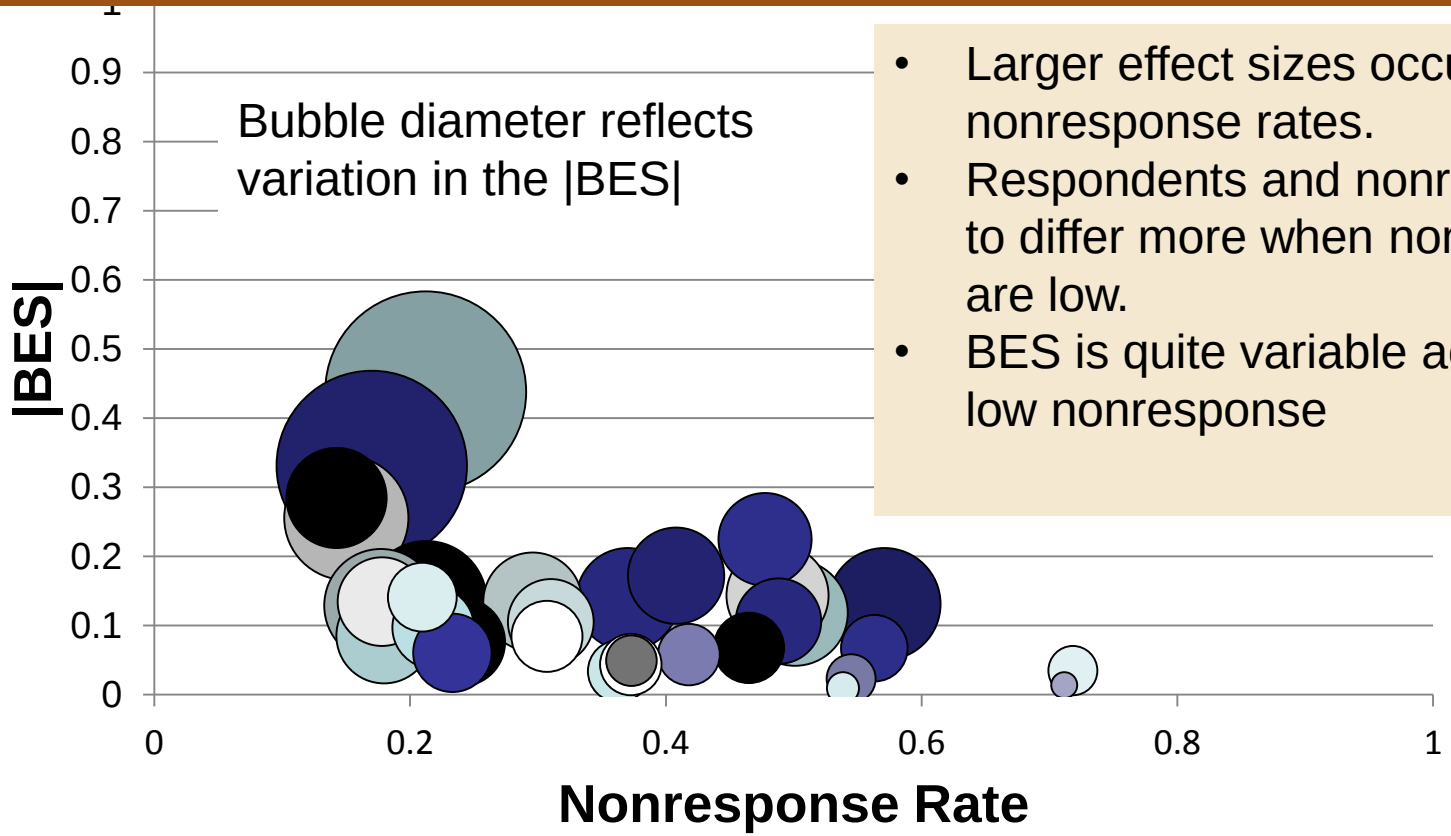

- Larger effect sizes occur for lower nonresponse rates.
- Respondents and nonrespondents tend to differ more when nonresponse rates are low.
- BES is quite variable across items for low nonresponse

Peytchev & Biemer, 2010

Better methods for estimating $\bar{y}_{NR}$ are needed

Traditional methods

- Use extra efforts to convert nonrespondents such as:
  - incentives or greater incentives
  - shortened questionnaire
  - better interviewers
- External data sources
  - Administrative records

New methods

- Social media
- Selective matched case substitution
  - Used in list surveys with rich frames
  - Matched subs provide an estimate of $\bar{y}_{NR}$

6. Real-time Interventions to Improve Data Quality

- Increasing $\rho|\boldsymbol{X}$
  - Enhanced call-back strategies
  - Tailored or model-guided (differential) incentives
  - Interviewer refusal/noncontact aversion training
  - Selective matched-case substitution
- Reducing measurement error
  - CARI monitoring and feedback
  - Alternate language questionnaires
- Reducing sampling error
  - Monitoring and controlling unequal weighting effects
  - Model-aided and adaptive sampling
- Reducing frame error
  - Open half-interval for field surveys
  - Check-list methods (e.g., CHUM)

7. Total survey error monitoring in real time

- Detection of interaction effects and the unintended consequences of error risk mitigation
  - CARI to mitigate interviewer fabrication
  - Multiple indicators to detect increases in measurement error
  - Graphical displays of interdependent metrics to detect unwanted interactions
- Metrics designed to simultaneous monitor multiple error sources
  - Classification error and nonresponse bias
  - Nonresponse followup and interviewer performance issues
  - Frame deficiencies and sampling error
  - Unequal weighting effects and nonresponse subsampling

8. Post-survey statistical adjustment

- Optimal variables selection for adjustment, especially for modeling $\rho|\boldsymbol{X}$ and the calibration to external controls
- One step methods for nonresponse and coverage adjustments
- Weighting methods for two phase sampling that control unequal weighting effects (Singh, et al)
- Methods for incorporating abbreviated questionnaire followup in nonresponse adjustments (Kott, 2017)

My Top 5 Research Priorities

1. Effective, real-time interventions to mitigate nonresponse error
2. Practical/effective methods for separating common and special cause variation in time series visualizations
3. Valid indicators of nonresponse, measurement error and their interactions
4. Innovative, low-cost approaches to training survey managers on the principles of adaptive design strategies and tools
5. Published examples illustrating the effectiveness of adaptive design approaches to improve data quality