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# Assessment of Plumbing Code Enforcement in the United States

Kyle Onda

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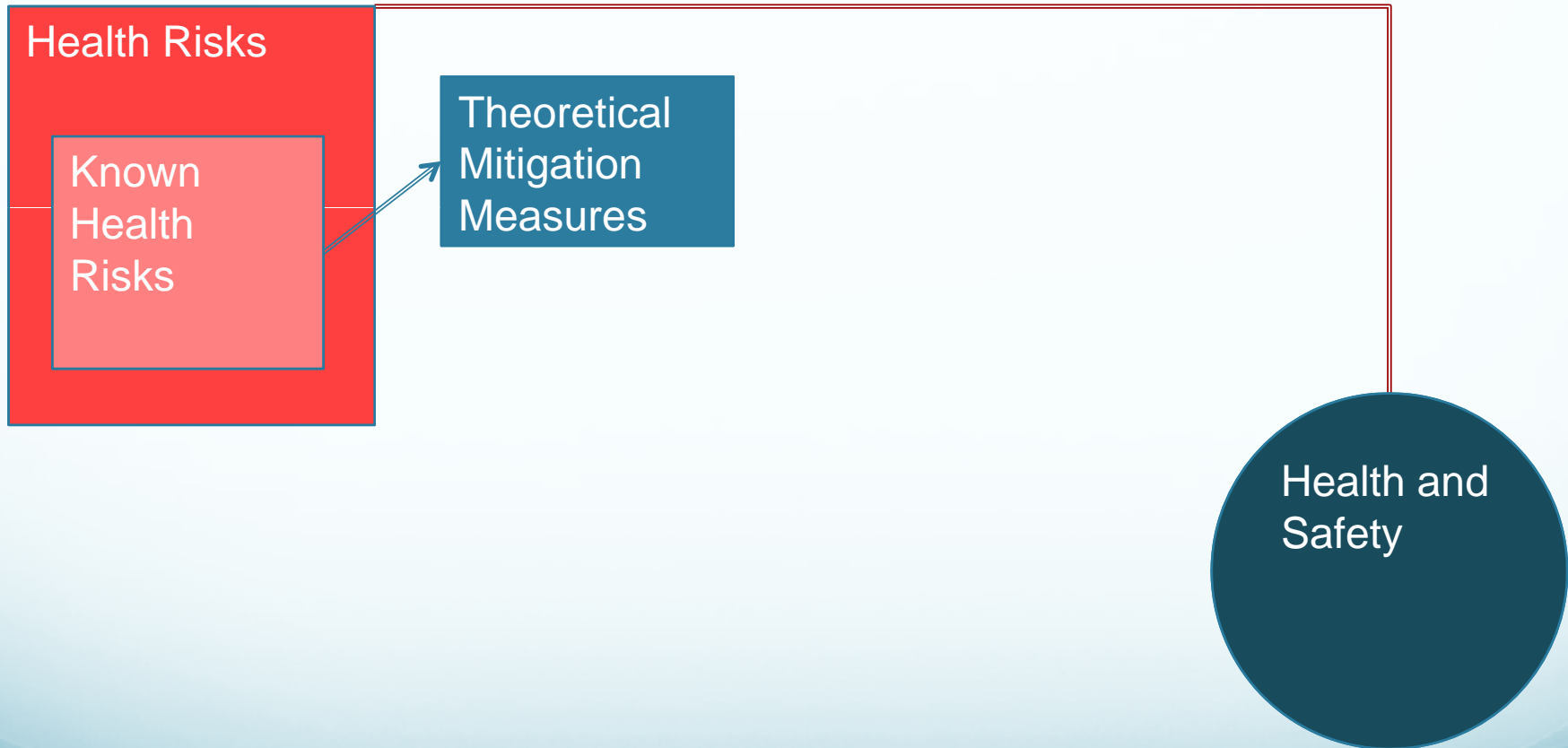
Alexandria, VA

2014 Emerging Technology Symposium

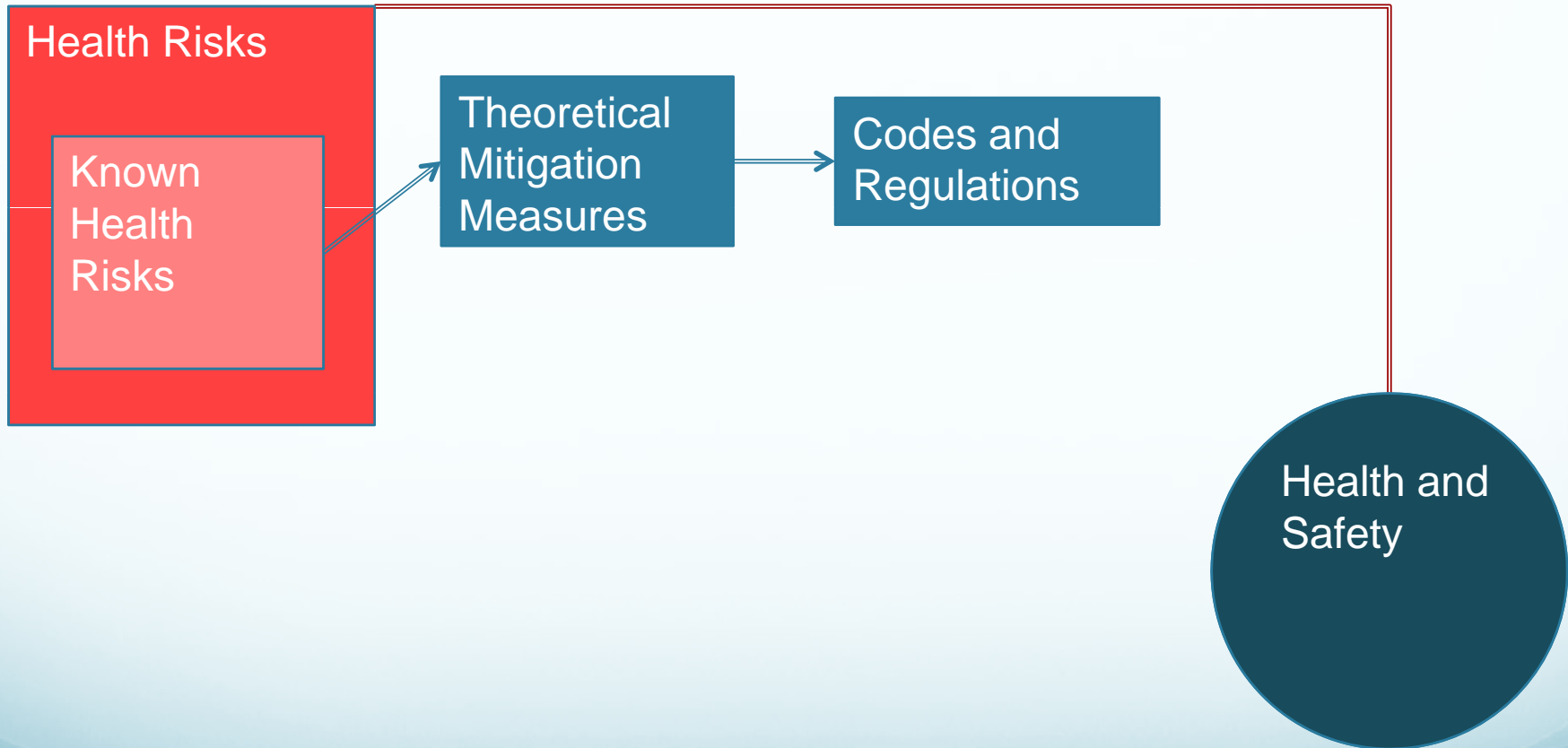
# Introduction



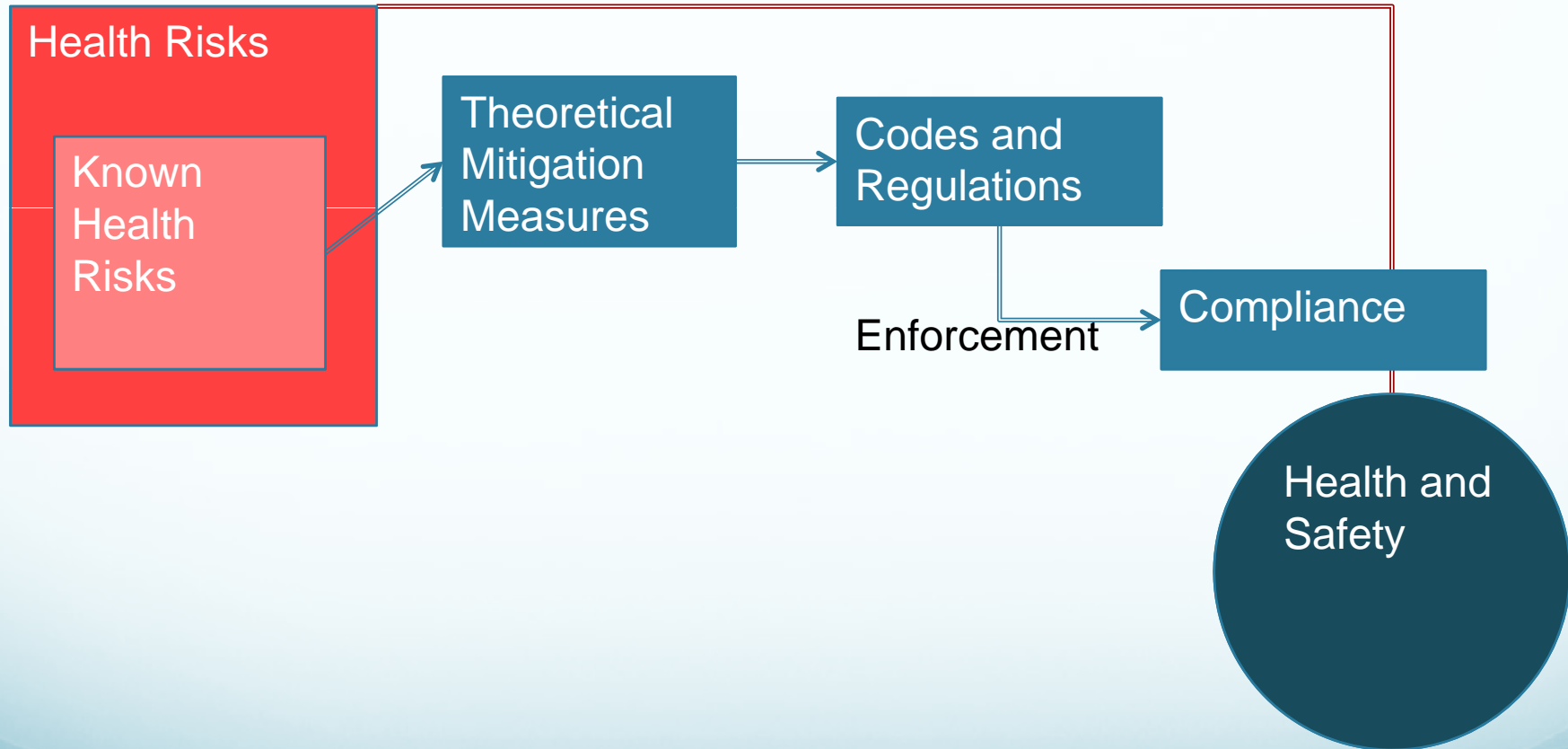
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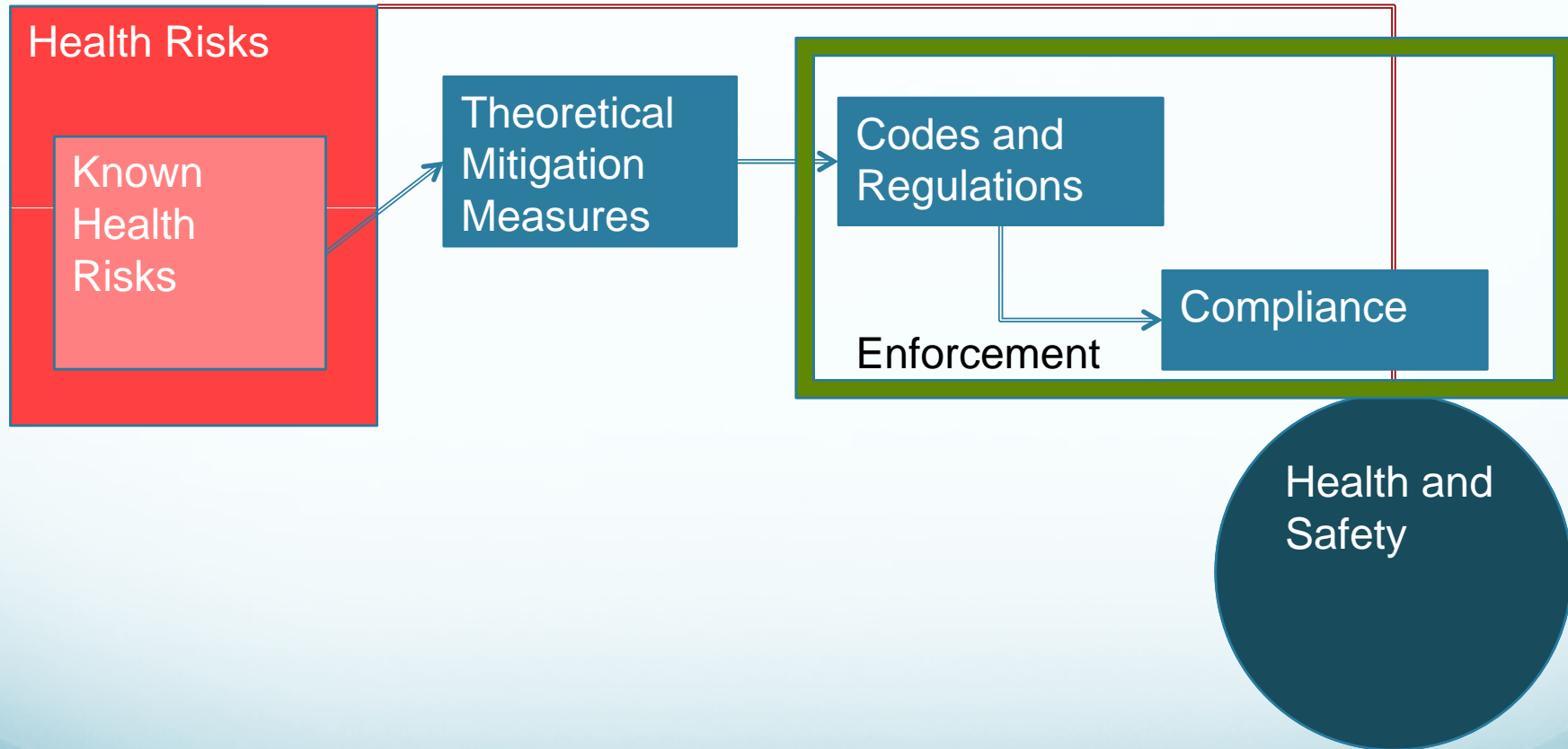
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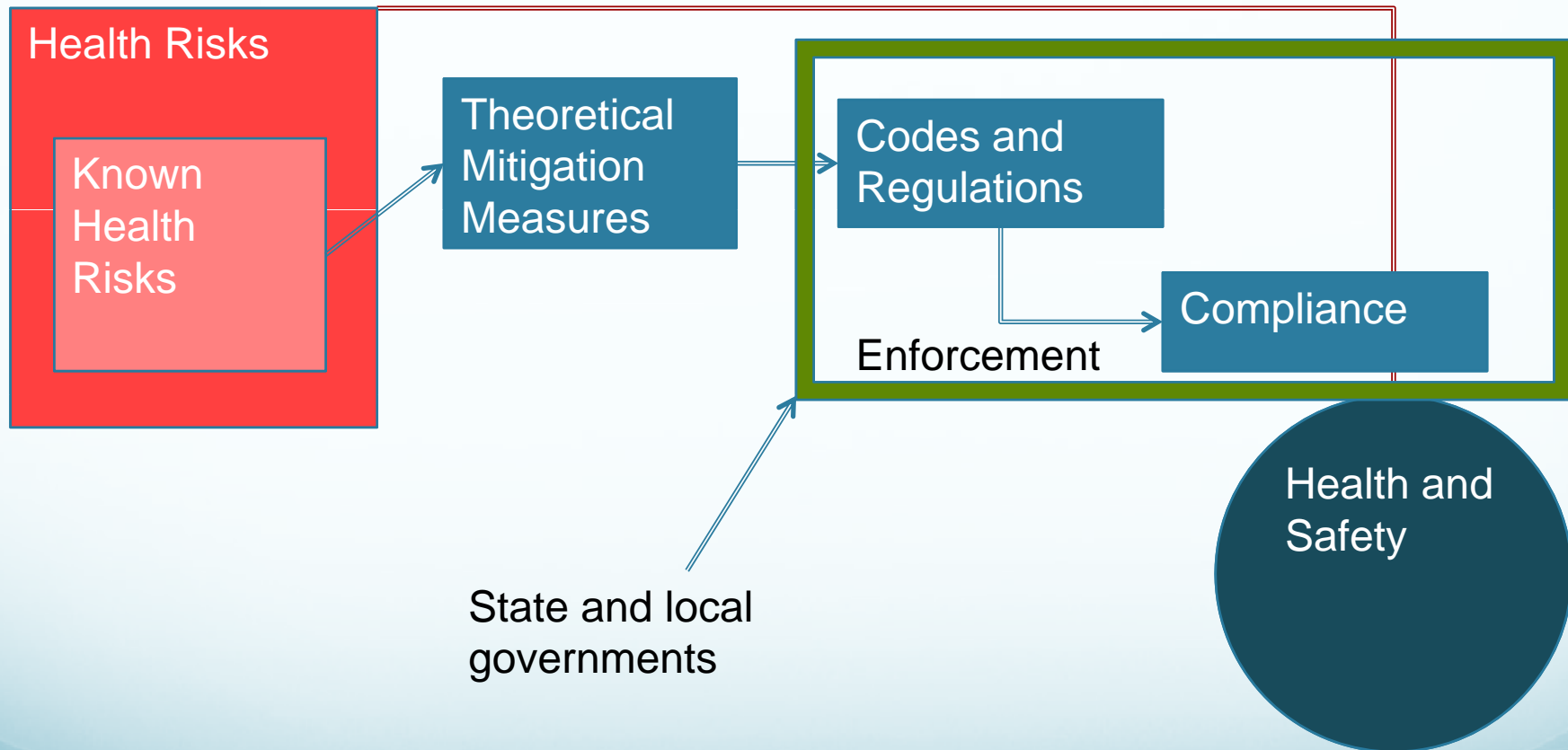
# Introduction



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# Outline

- State plumbing code enforcement regimes
  - Dimensions of state code enforcement
  - Categorization of code enforcement regimes
- Local plumbing code enforcement official survey
  - Capacity
  - Effort
  - Strategies



# Dimensions of State Code Enforcement

- Type of plumbing code
- Local enforcement role
- Local discretion
- Standardization of local enforcement
- State review of local enforcement
- State revocation of local enforcement



# Dimensions of State Code Enforcement

- Type of plumbing code
  1. No code
  2. Enabling code
  3. Mandatory statewide code

# Dimensions of State Code Enforcement

- Local Enforcement Role
  1. State delegates to local government on an individual basis
  2. Broad authorization of local code enforcement
  3. Mandatory local enforcement

# Dimensions of State Code Enforcement

- Local discretion: How local code enforcement agencies are permitted to amend the state code
  1. Prohibited
  2. Can make more stringent with state permission
  3. Can amend to suit local conditions with state permission
  4. Can amend the code or adopt a different code without state permission

# Dimensions of State Code Enforcement

- Local Standardization
  1. No particular requirements
  2. State prescription of requirements for personnel certification, allowable enforcement actions, record-keeping, and other administrative procedures

# Dimensions of State Code Enforcement

- State Review
  1. No state review of local enforcement
  2. Review process of vague frequency
  3. Reviews initiated based on complaints to state officials
  4. Mandatory, regular/ periodic reviews

# Dimensions of State Code Enforcement

- State Revocation
  1. State reserves right to revoke authority of local agencies to conduct inspections and issue permits
  2. No mention

# Dimensions of State Code Enforcement

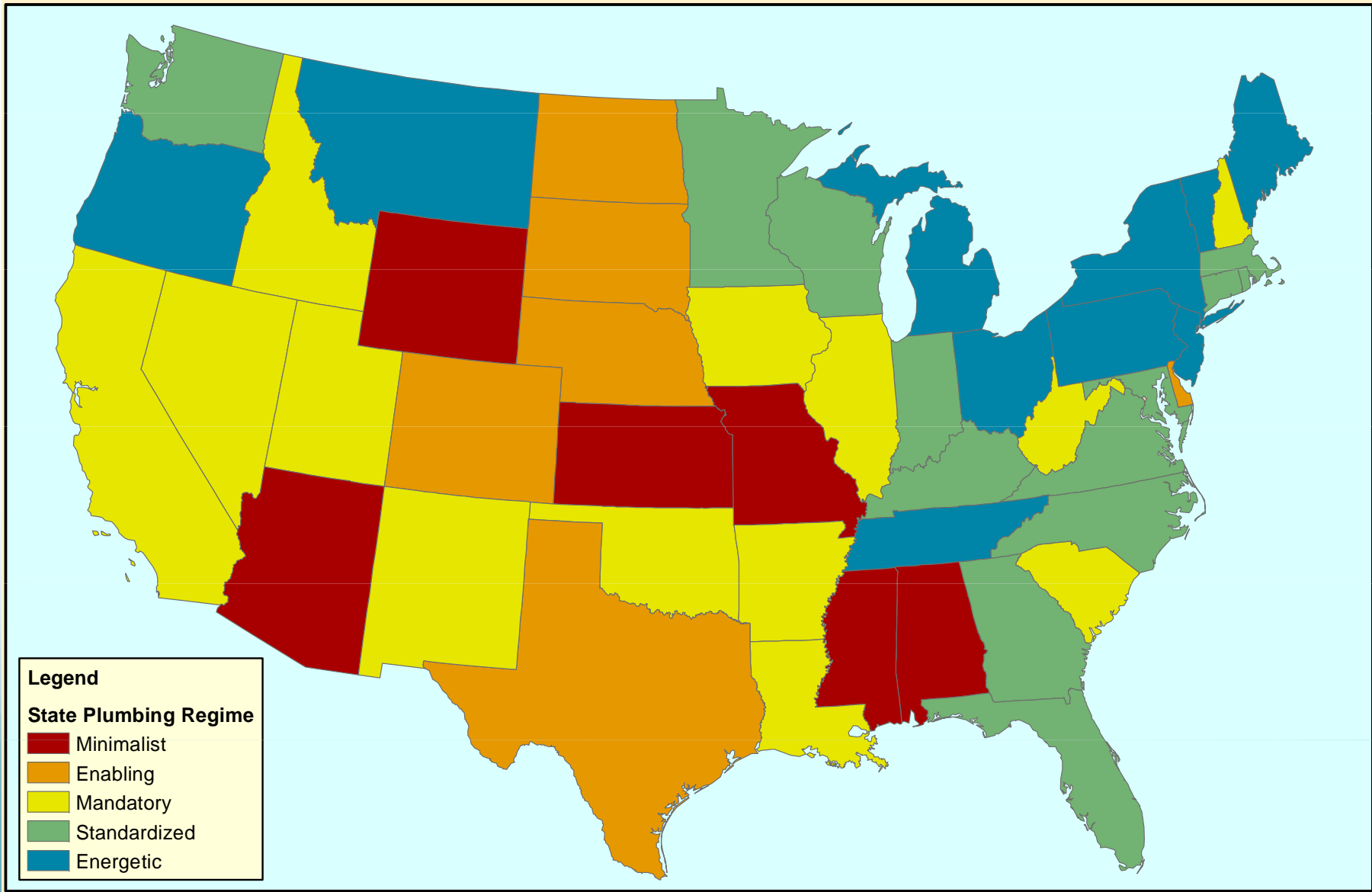
- State Revocation
  1. State reserves right to revoke authority of local agencies to conduct inspections and issue permits
  2. No mention



# U.S. State Plumbing Code Enforcement Regimes

1. **Minimalist:** No state code or enforcement requirements
2. **Enabling:** State adopts a plumbing code that local governments may amend without permission
3. **Mandatory:** State has mandatory statewide code and disallows local amendments or requires permission, and may enforce codes directly
4. **Standardized:** Like mandatory states, but also standardize local enforcement programs
5. **Energetic:** Like standardized, but periodically review, and may revoke, local enforcement programs

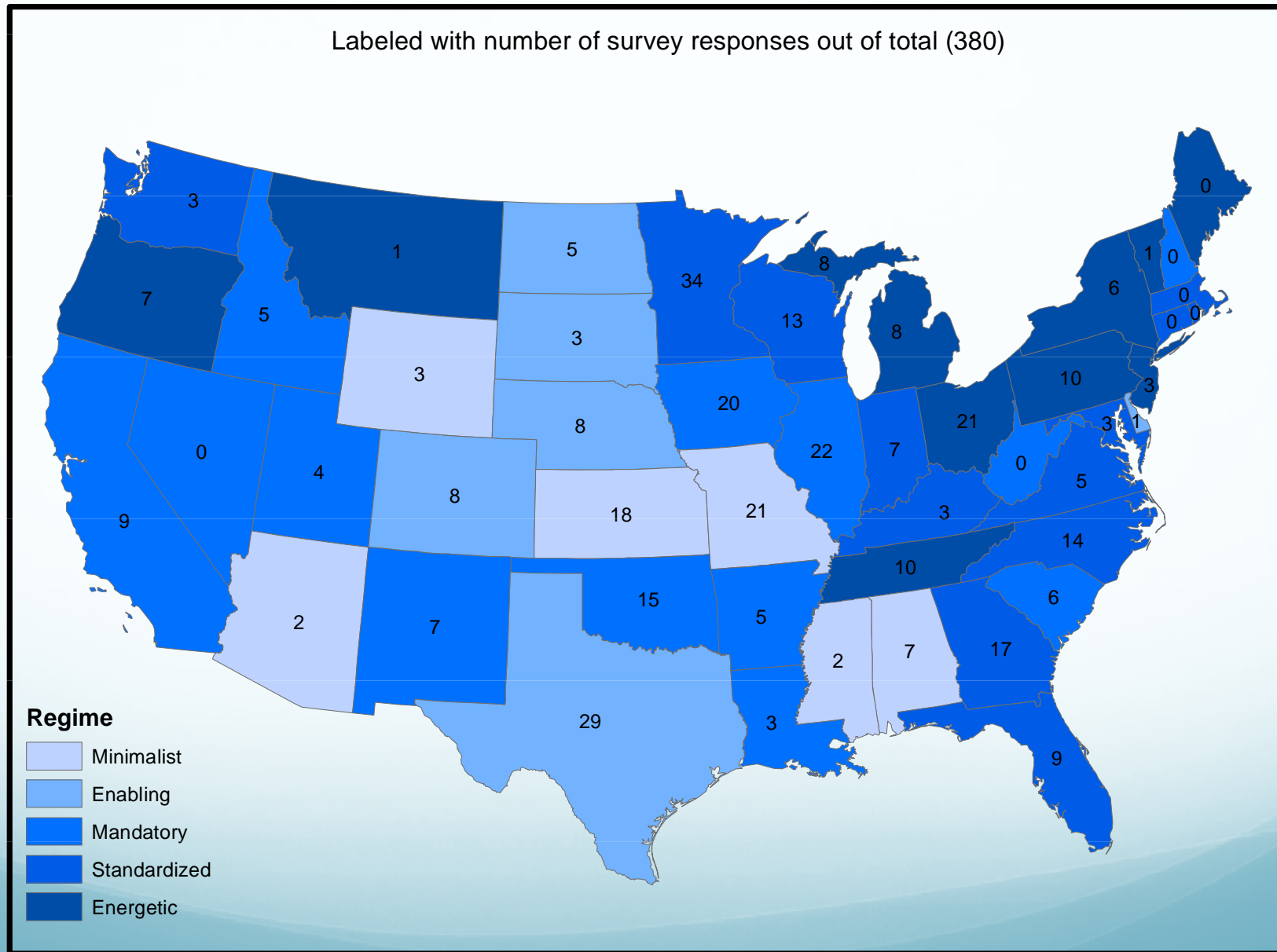
# U.S. State Plumbing Code Enforcement Regimes



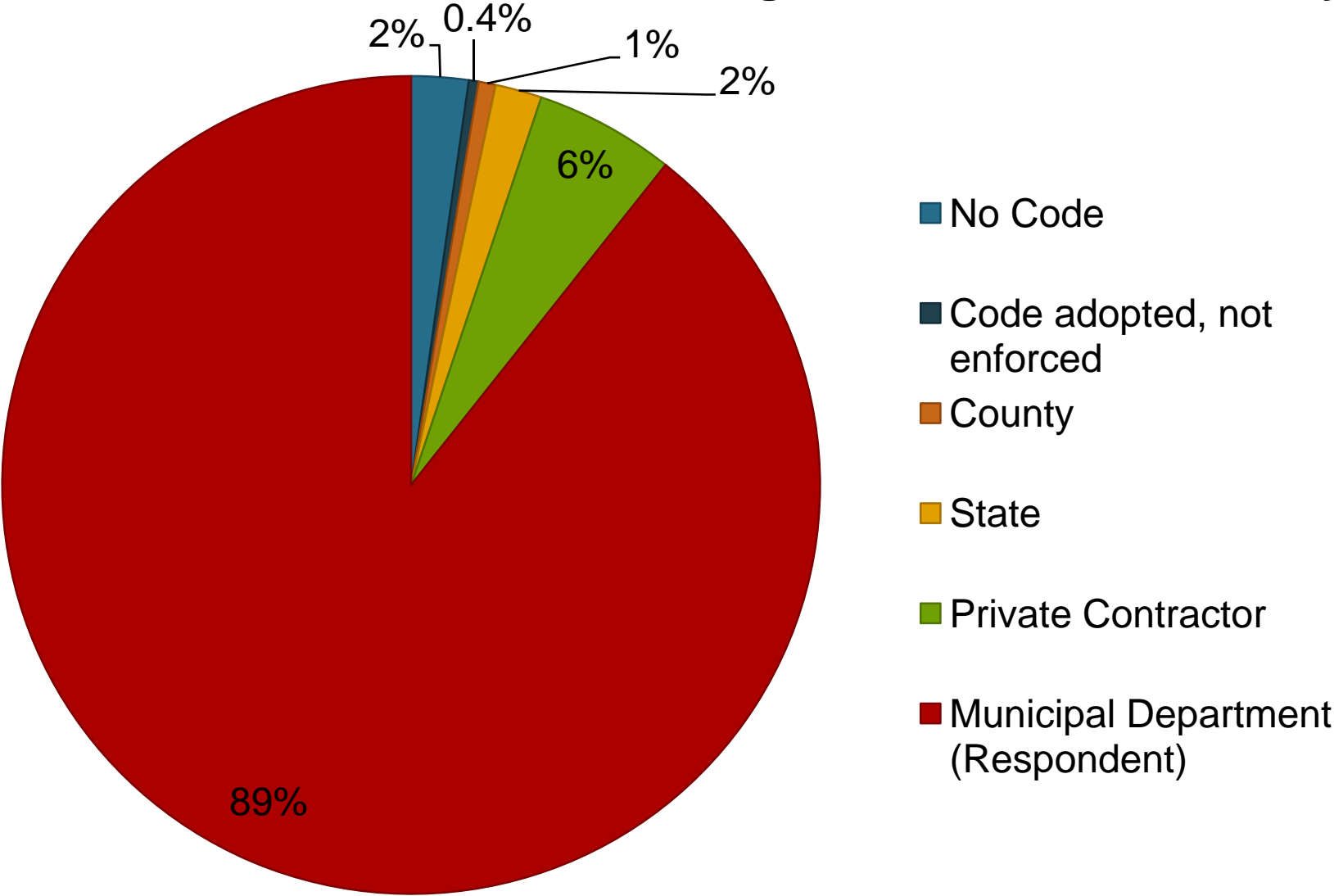
# Nationally Representative Plumbing Enforcement Official Survey

- Asked about enforcement practices, agency capacity, effort expended on different activities, perceived compliance
- ~2500 Agencies selected with probability proportional to population of jurisdiction
- Each response weighted according to this probability

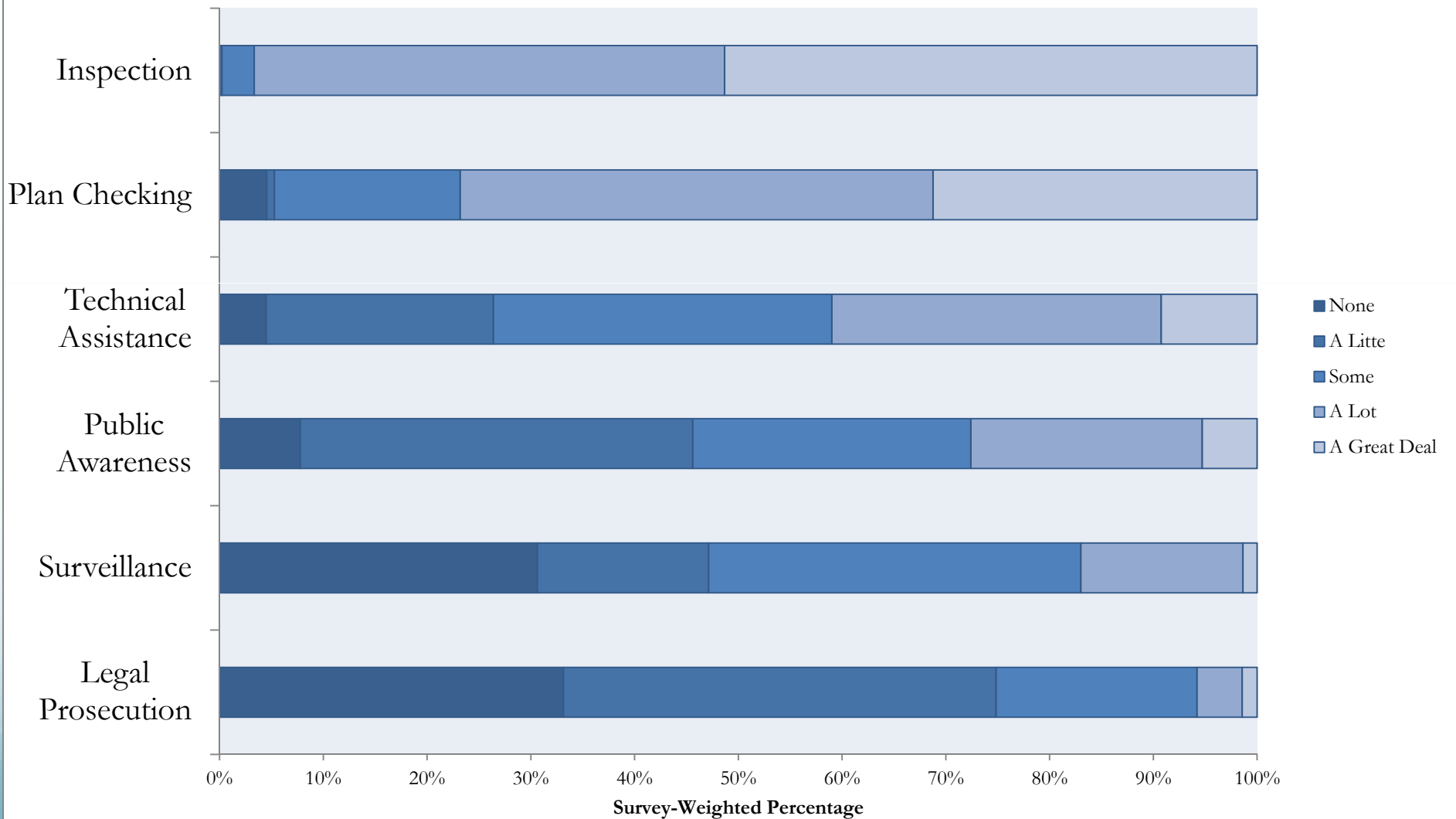
# U.S. State Plumbing Code Enforcement Regimes



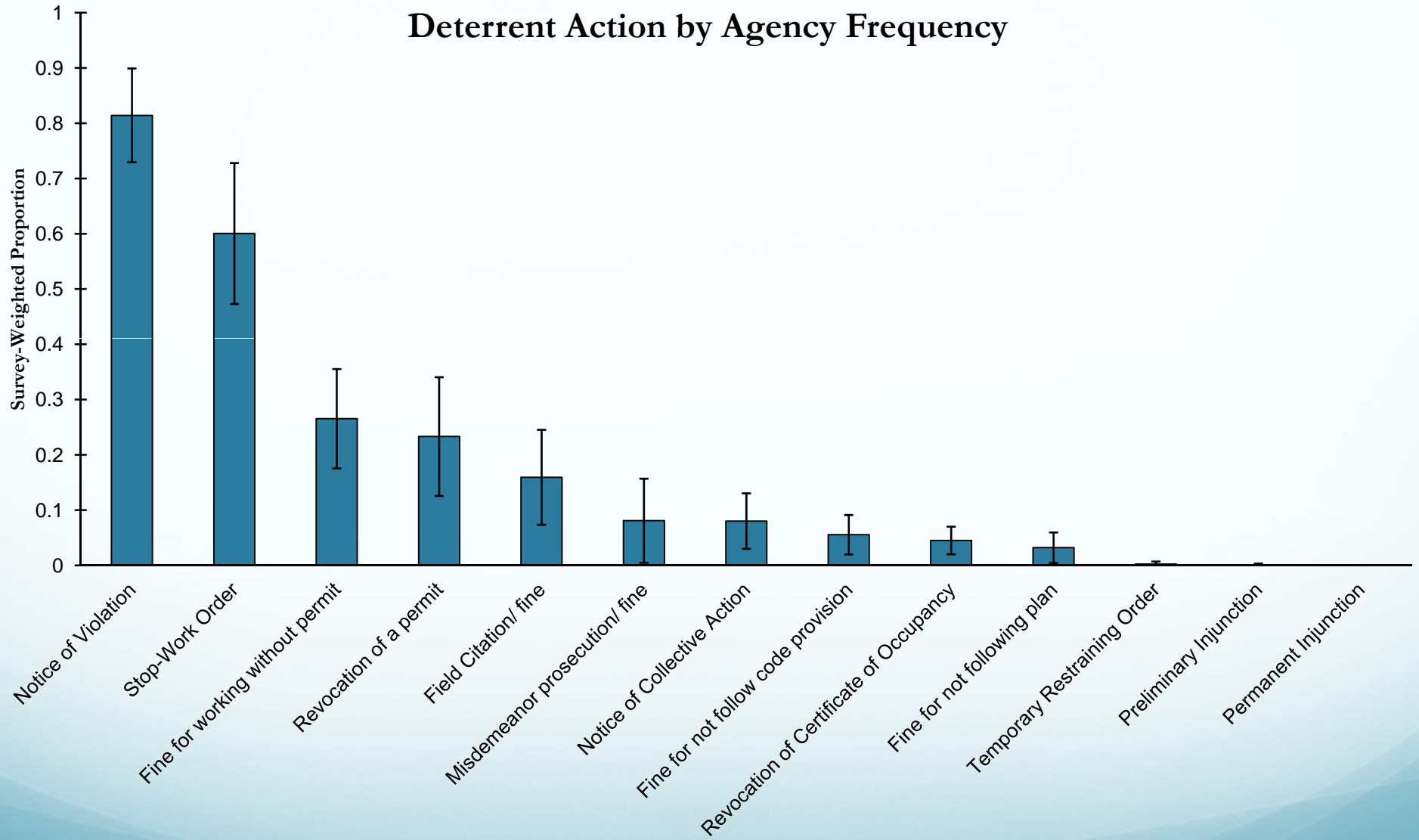
# Plumbing Code Enforcement Body



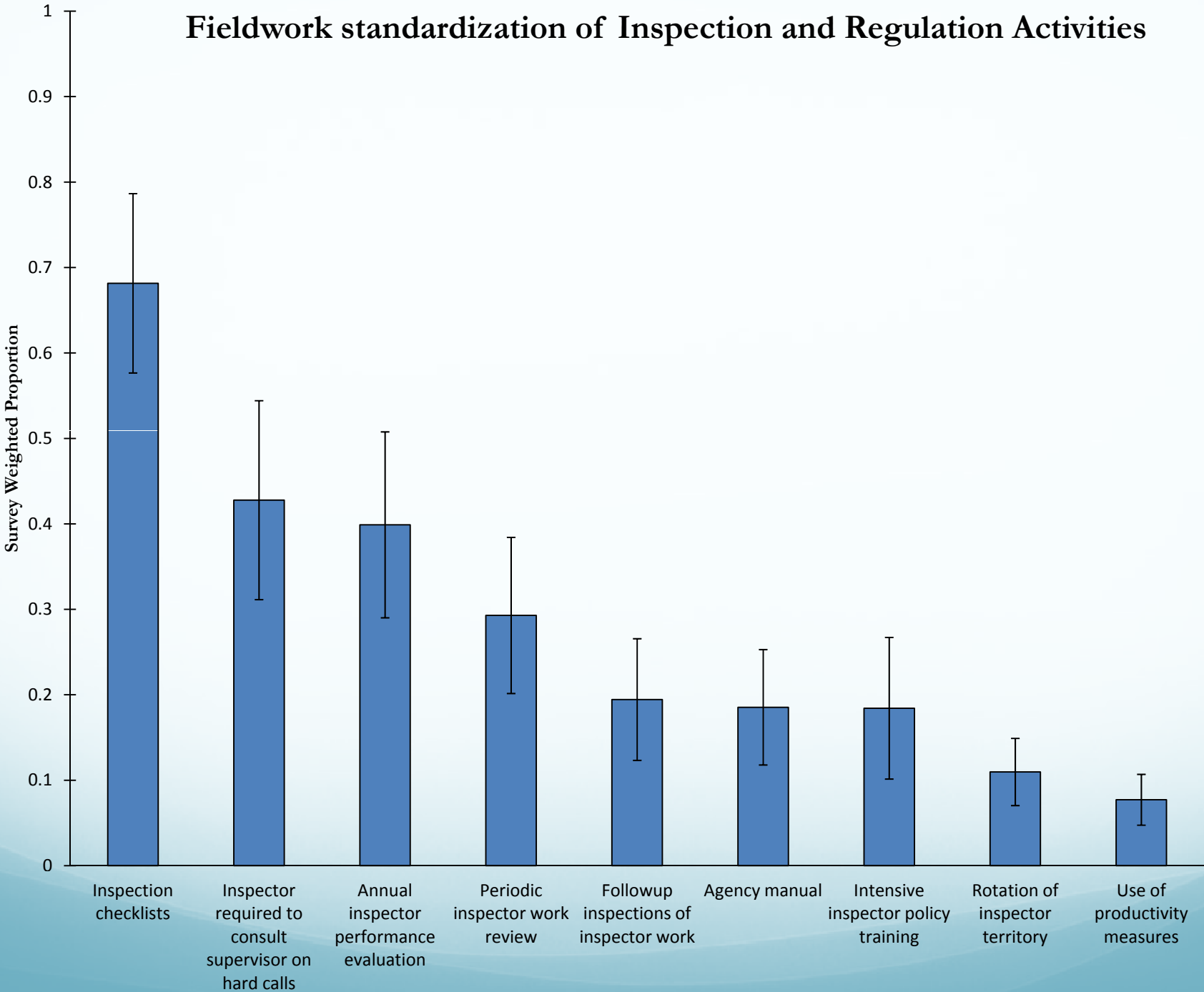
## Self-Reported Effort by Activity



## Deterrent Action by Agency Frequency

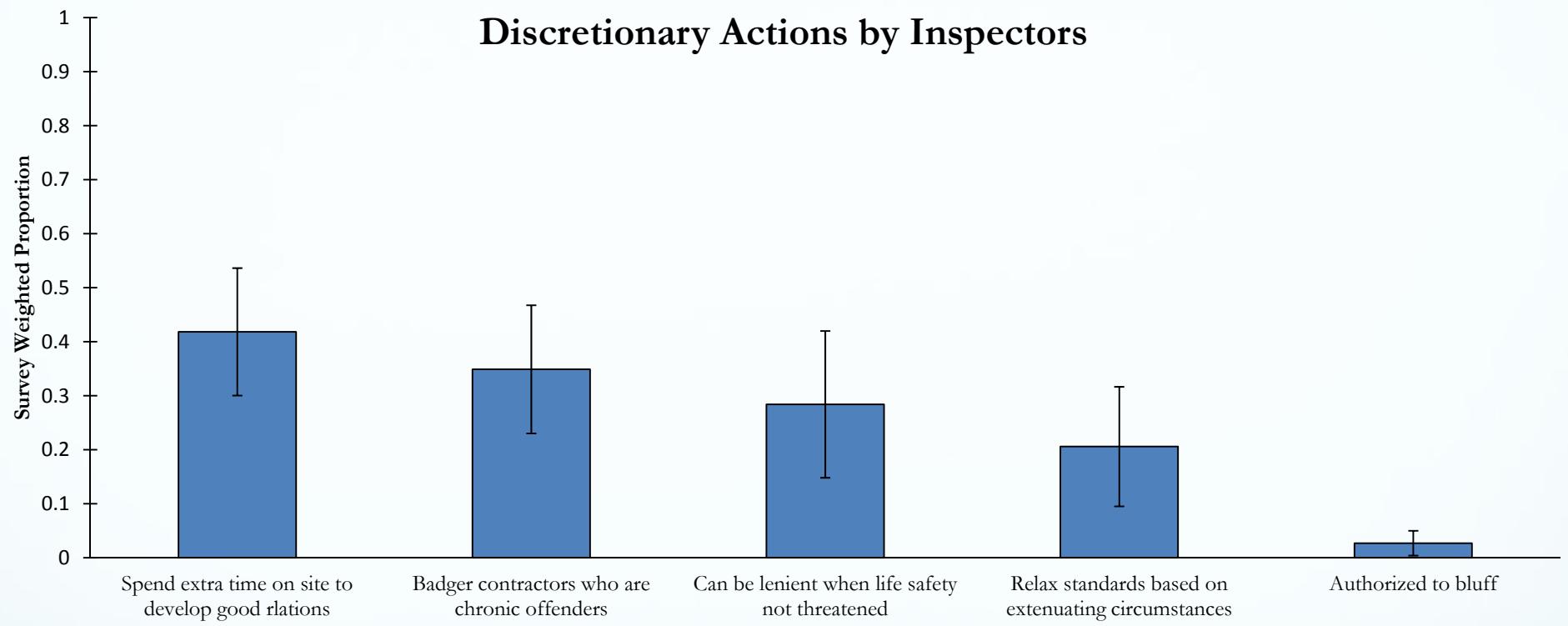


# Fieldwork standardization of Inspection and Regulation Activities

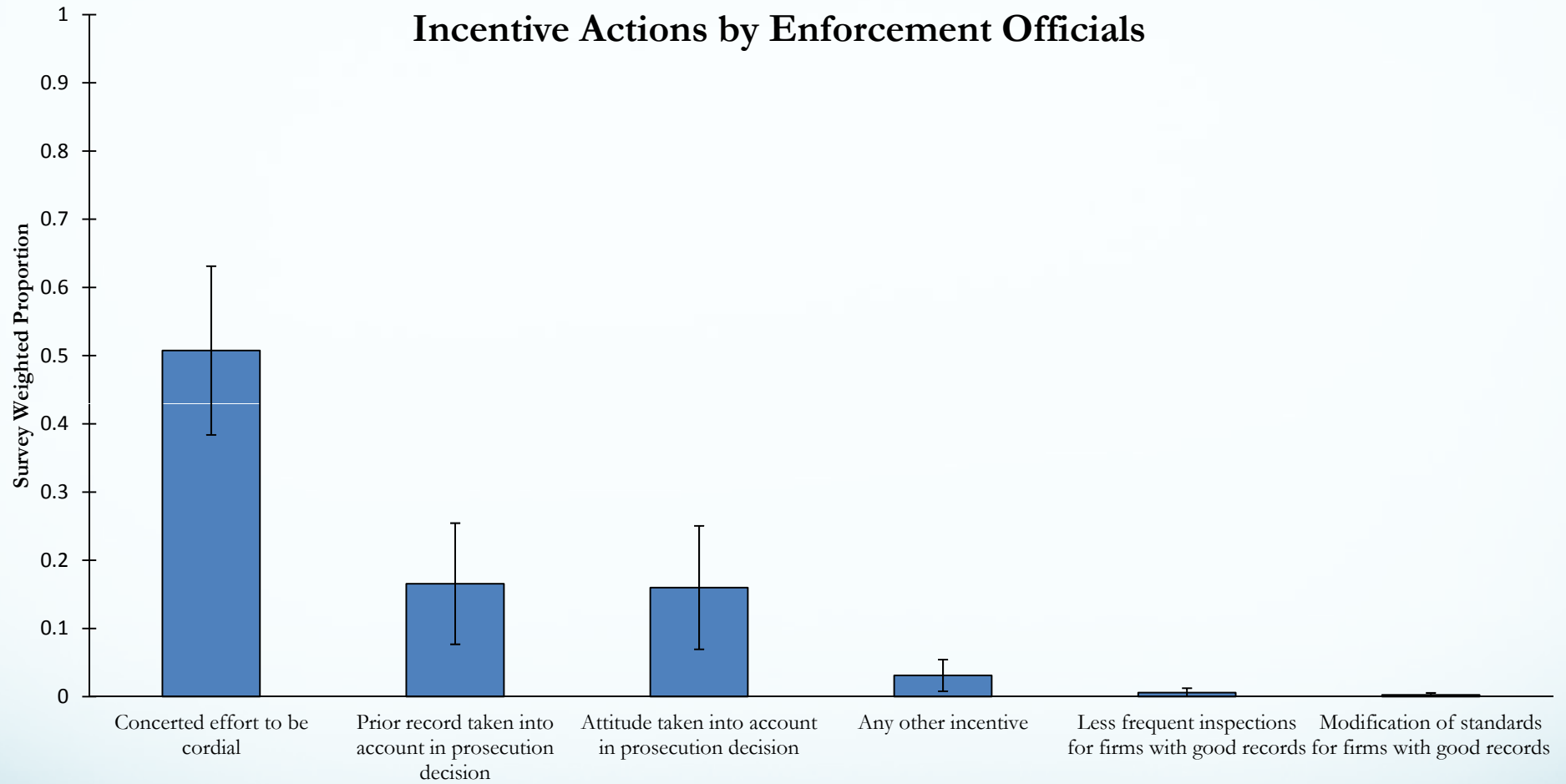




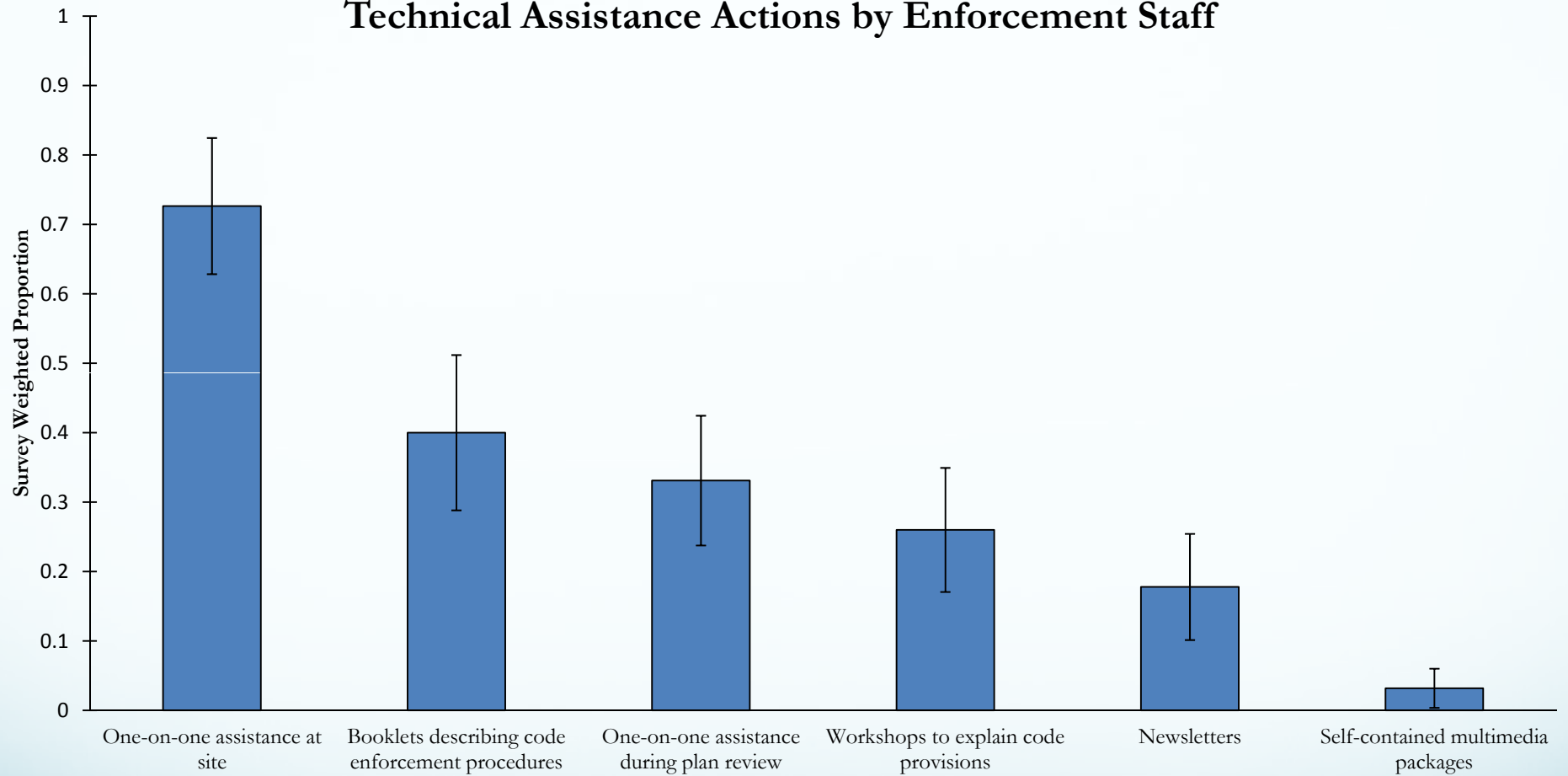
# Discretionary Actions by Inspectors



## Incentive Actions by Enforcement Officials



## Technical Assistance Actions by Enforcement Staff



# Factor Analysis

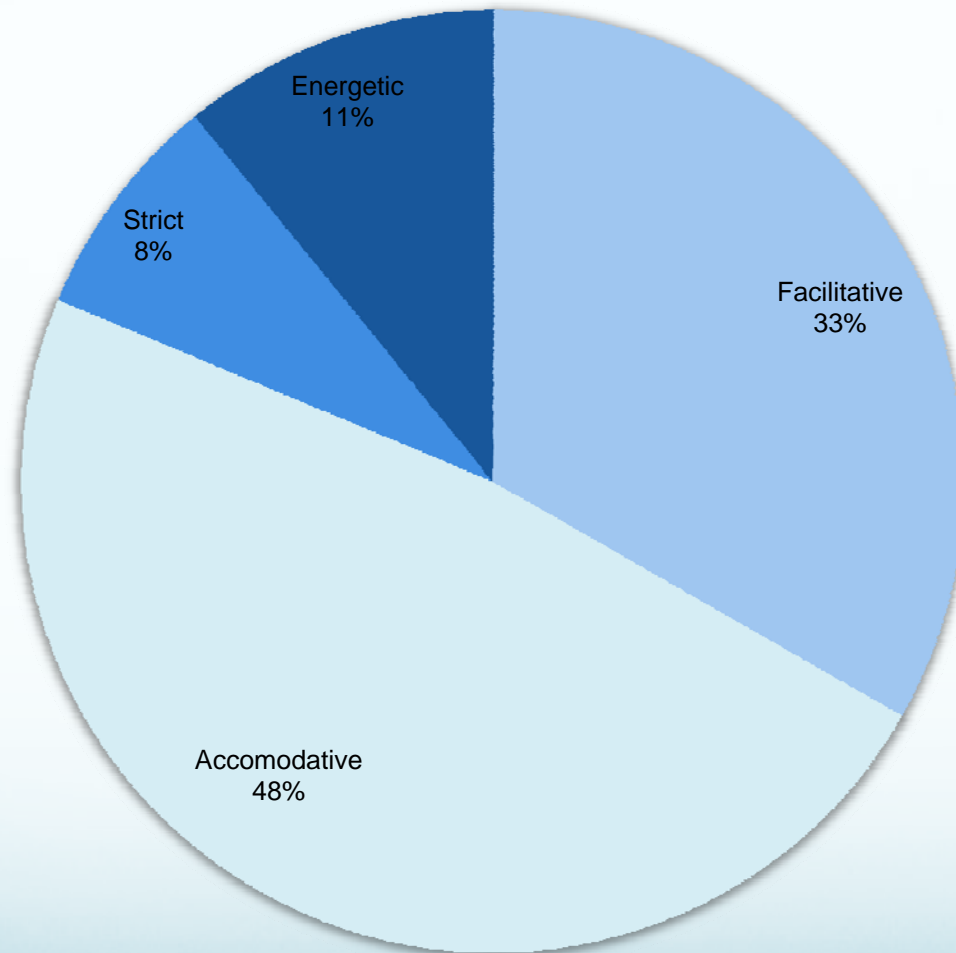
Action Category	Systematic Philosophy	Facilitative Philosophy
Deterrent	<b>0.55</b>	0.28
Standardization	<b>0.66</b>	0.14
Discretion	0.08	<b>0.58</b>
Incentives	0.24	<b>0.64</b>
Technical Assistance	<b>0.53</b>	0.13

# Cluster Analysis

**Agency Strategy**

○ Facilitative   ■ Accomodative   × Strict   + Energetic

## Survey-Weighted Agency Strategy Distribution

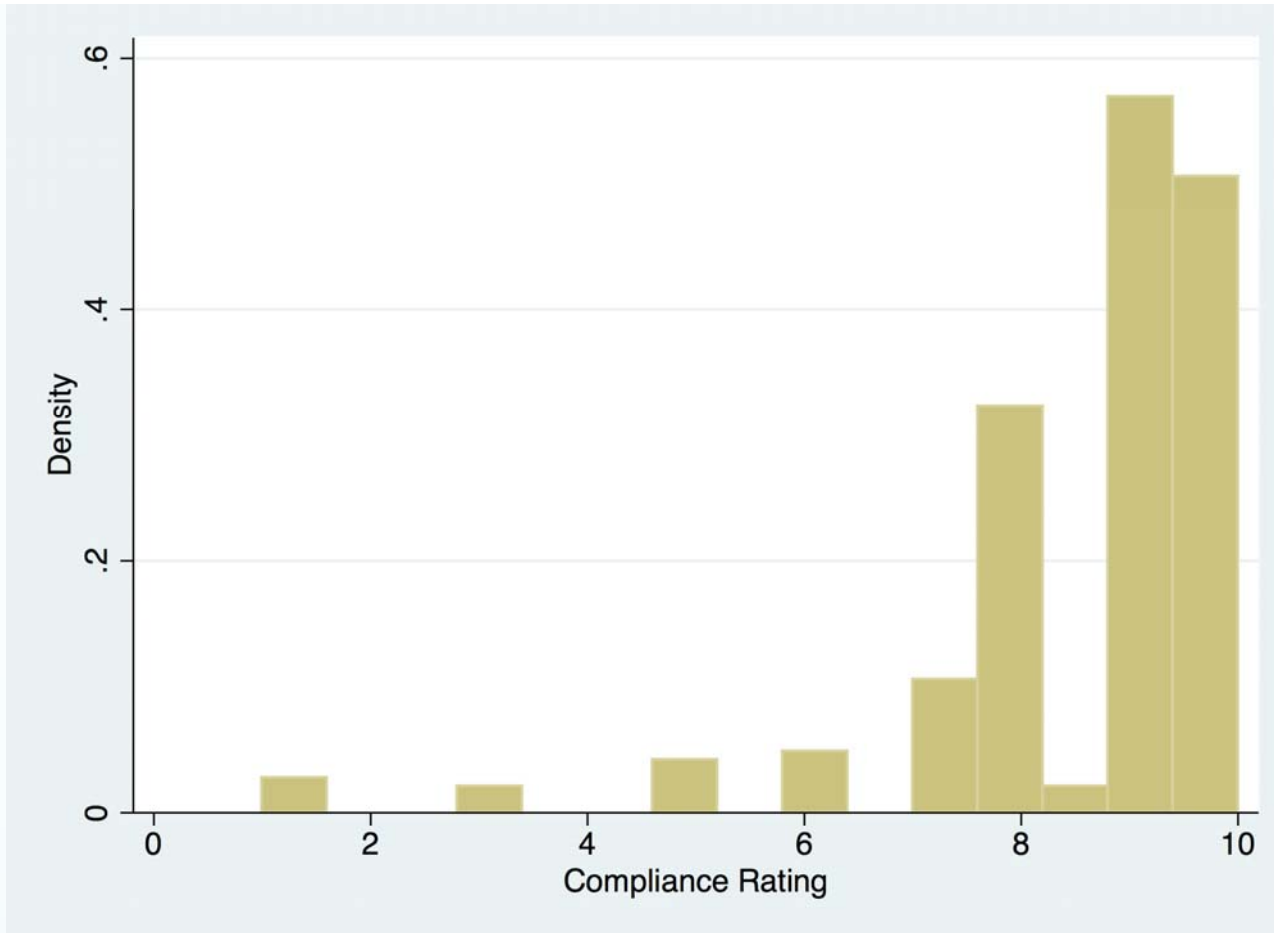


### Local Strategy

		Local Strategy				
		Accomodative	Facilitative	Strict	Energetic	<b>Total</b>
State Regime	Minimalist	0.04	0.0357	0.002	0.007	0.0847
	Enabling	0.0603	0.0669	0.0059	0.0144	0.1475
	Mandatory	0.0943	0.0629	0.0261	0.0508	0.2341
	Standardized	0.1132	0.0968	0.0374	0.0075	0.2549
	Energetic	0.1725	0.0704	0.0067	0.0293	0.2789
	<b>Total</b>	0.4803	0.3327	0.0781	0.109	1

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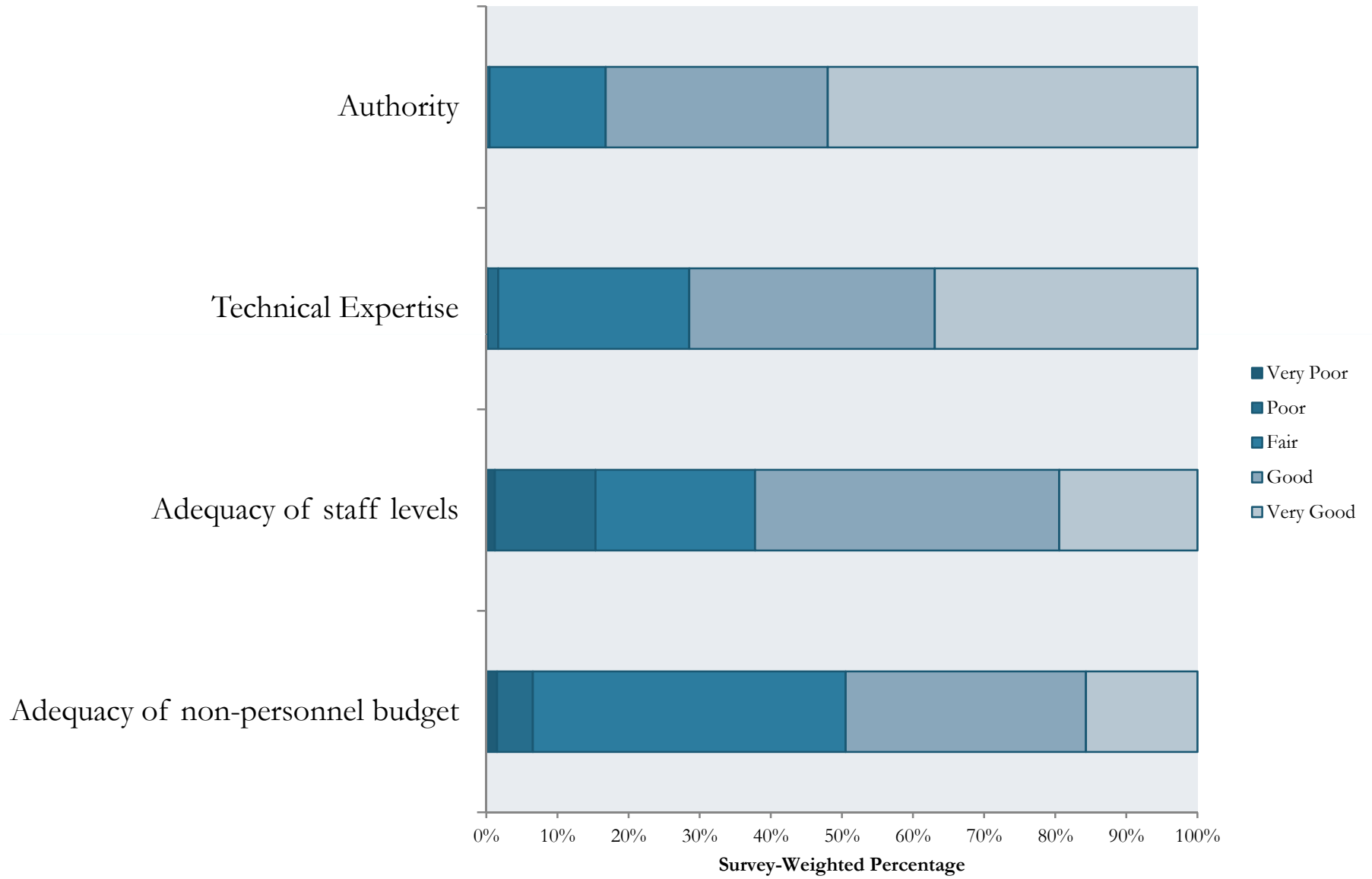




### Local Strategy

	Local Strategy				
	Accomodative	Facilitative	Strict	Energetic	<b>Total</b>
Compliance >80%	0.4485	0.2669	0.077	0.1044	0.8968
Compliance <80%	0.0545	0.047	0.0018	0	0.1033

## Senior Enforcement Official Perception of Capacity

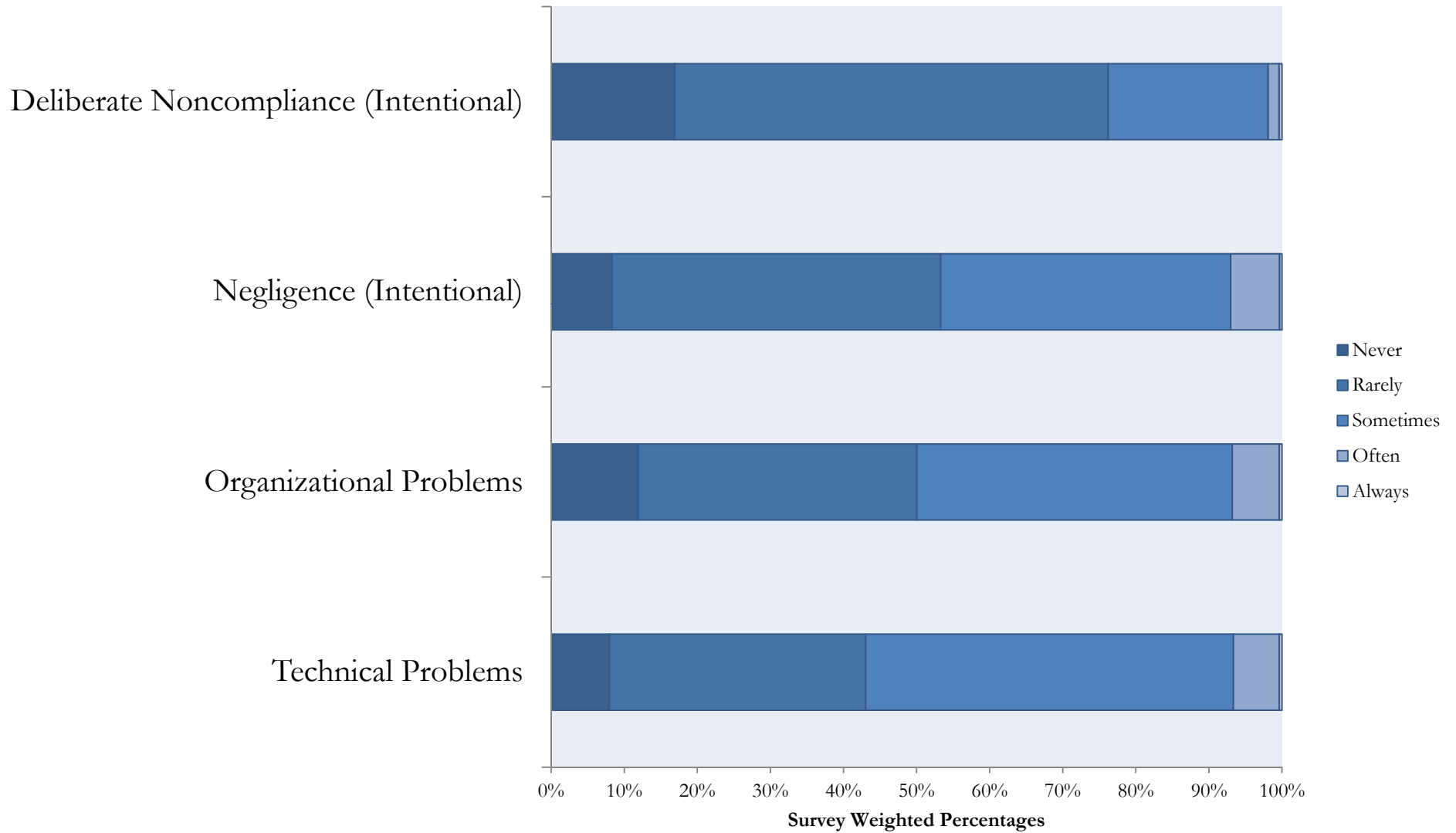


## Survey: Logistic regression

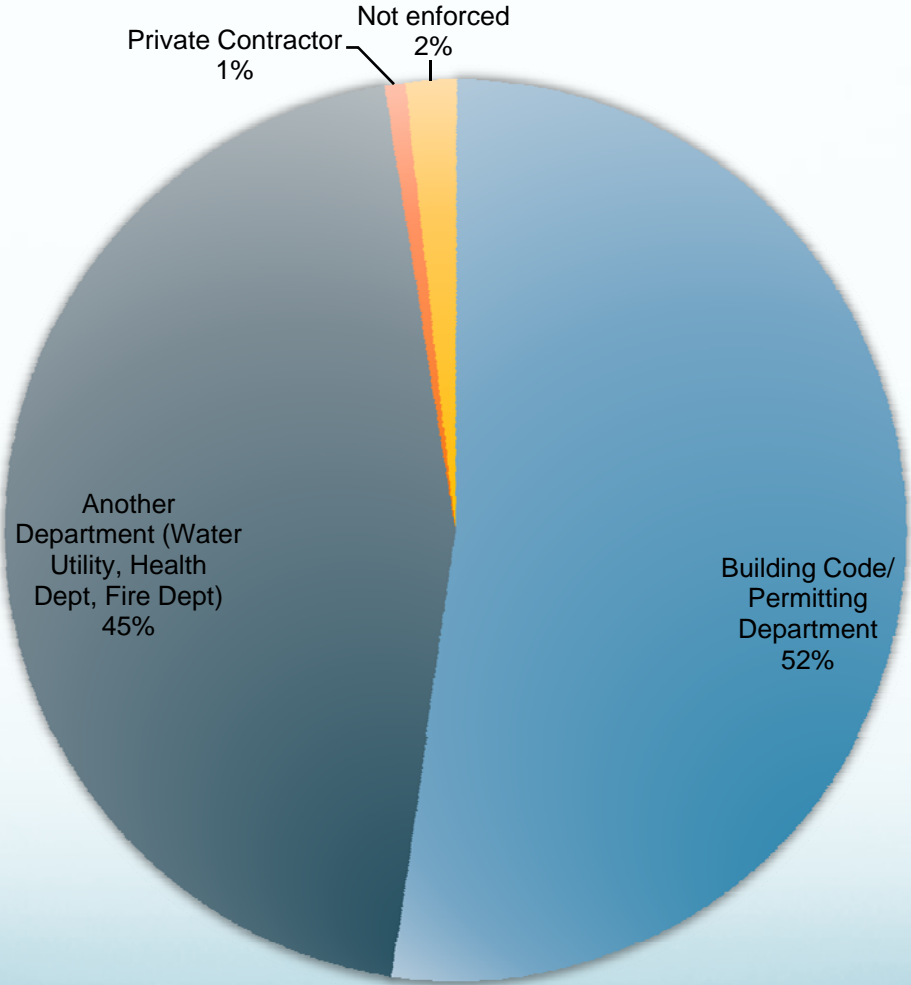
Number of strata = 1                      Number of obs = 223  
Number of PSUs = 223                      Population size = 956.24677  
Design df = 222  
F( 4, 219) = 1.26  
Prob > F = 0.2868

	Linearized					
compliance_low	Odds Ratio	Std. Err.	t	P>t	[95% Conf. Interval]	
Q14_1	.5746191	.2550187	-1.25	0.213	.2396305	1.377901
Q14_2	2.887707	1.529891	2.00	0.047	1.016528	8.203268
Q14_3	.8621996	.4217327	-0.30	0.762	.3288308	2.260701
Q14_4	.5105017	.2544239	-1.35	0.179	.1911832	1.363153
_cons	.6706524	.9807752	-0.27	0.785	.0375717	11.97111

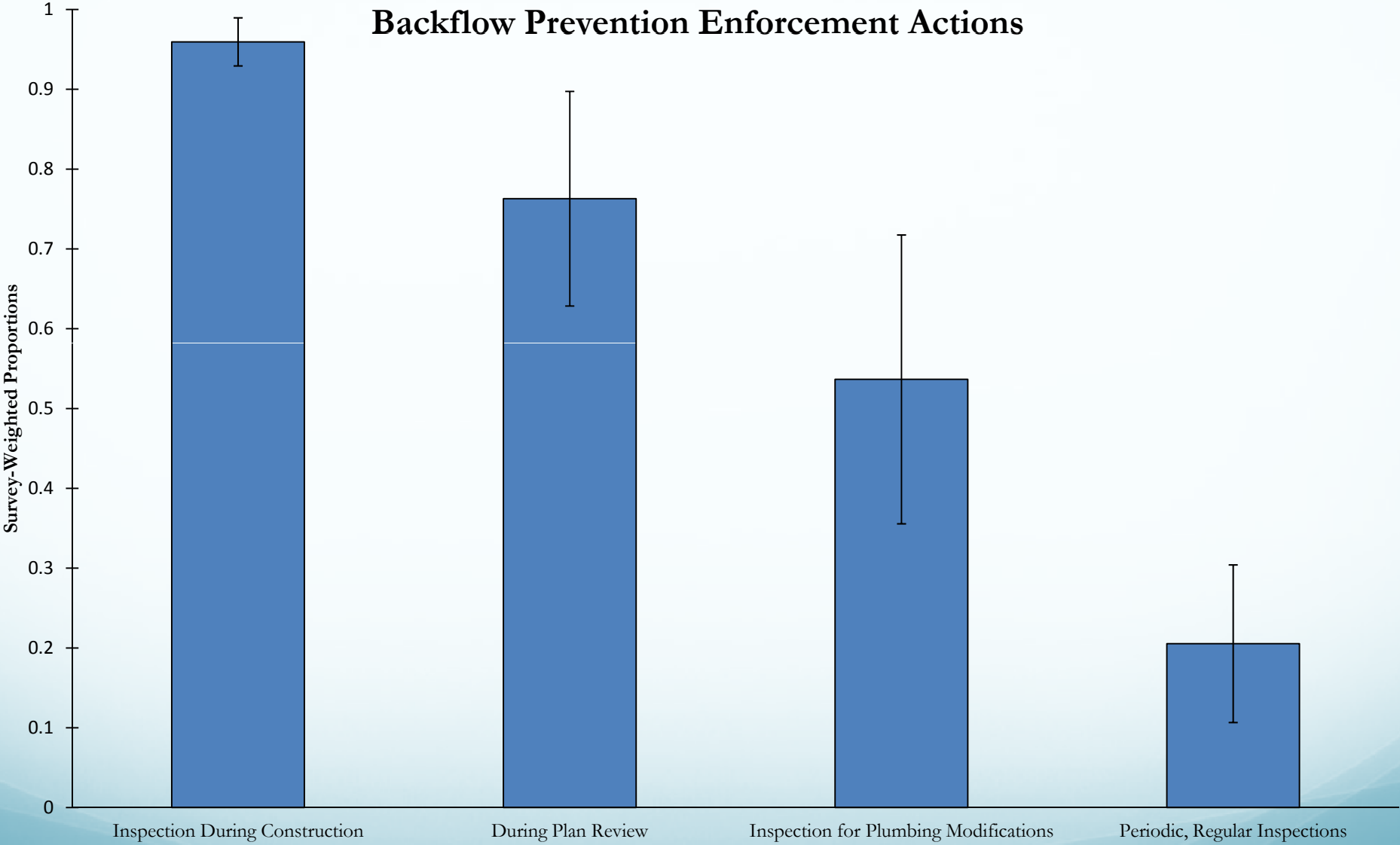
## Relative Frequency of Perceived Reasons for Violations



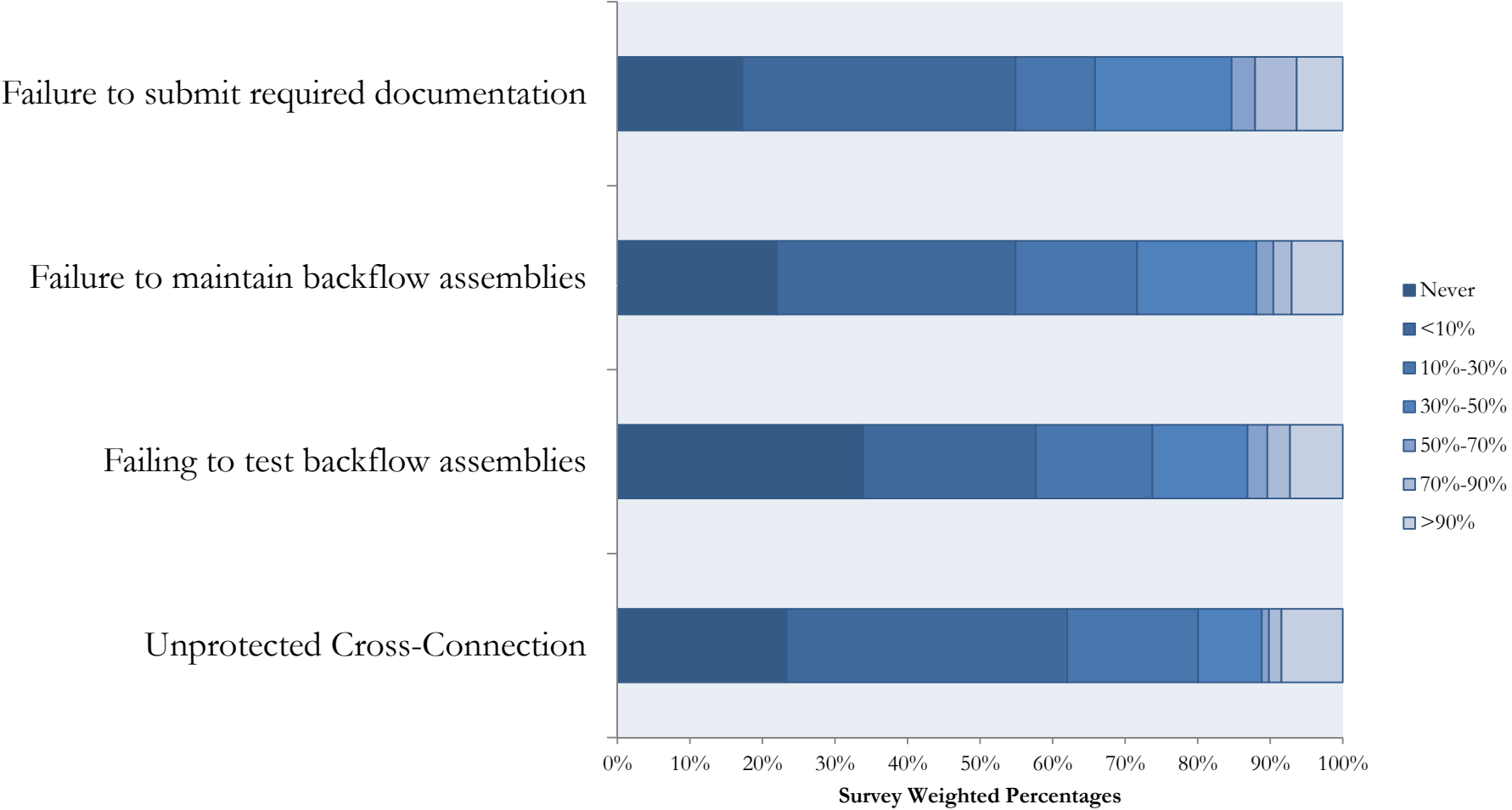
# Backflow-Prevention Enforcement Responsibility



# Backflow Prevention Enforcement Actions



## Relative Frequency of Backflow Violations



# Conclusions

- Wide variability in plumbing code enforcement practices at state and local levels
- Generally high perceived compliance rates
- Future research should explore the relationship between regulatory strategy, perceived compliance, and water quality outcomes





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# Acknowledgements

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IAPMO