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The 3Es (Education, Engineering, and Enforcement) of Fire Prevention Services in the Age of Local Government Retrenchment

Abstract

This project examines the effects of the Great Recession on cutback strategies for fire prevention services in local fire departments. Utilizing a convenience sample of fire prevention providers from the Vision 20/20 Fire Prevention Cuts Survey, we developed an ordinal scale of 3E provision using the services of plan review, new construction inspection, existing building inspection, public education, and fire/arson investigation. We found the anticipated concentration of these services within the local fire department as we moved from small/volunteer communities to metropolitan/career contexts. We also found that the departments in larger communities were the most likely to report cuts to fire prevention, implying that larger populations may bear greater fire risk during periods of financial retrenchment. To some extent, cuts to fire prevention can be offset if fee-service activities like plan review are located within the local fire department. Likewise, large career departments are significantly more likely to engage in compensatory actions to offset the implications of budget and personnel cuts.

Keywords: fire service, fire prevention services, cutback management, Great Recession

For fire service leaders, the challenge of justifying and maintaining expenditures for fire prevention occurs within the larger context of external budget pressures on federal, state, and local governments. Given the vertical nature of funding streams, budgetary choices are subject to the reverberating effects of global economic events. In slightly more than a decade, we have experienced two depression-scale events: the 2008 global financial crisis and the 2020 COVID-19 pandemic shutdown. These volatile economic cycles remind us that, for many departments, a return to significant cutback strategies may be near.

Anecdotal evidence suggests that fire prevention programs are among the first items to be cut when fire departments face financial hardship. This project examines the 3E*s* of fire prevention — Education, Engineering, and Enforcement — used to manage cutbacks during the 2008 global financial crisis and its protracted recovery. We used the original responses given by fire officials to investigate the different structures through which 3E services are provided and the strategies used to implement constraint-driven budget cuts. While our findings are rooted in the Great Recession (2007-2009), they clearly apply to future economic cycles that will constrain available resources in the years to come.

Preventative 3E Services

Traditionally, the fire service has taken a reactive approach to its core mission and focused on fire suppression. However, the *America Burning* initiative ushered in a historical reduction in fire incidents and losses (National Commission on Fire Prevention and Control, 1973). Most of these declines were tied to improvements in engineering and an increased emphasis on public education. The reduction in fire incidents and losses also allowed fire departments to expand their mission and address other community risks. Subsequent pressures, both internal and external, raised community health and safety expectations currently placed upon fire departments (Donahue, 2004).

The 3Es originated with President Truman's 1947 Conference on Fire Prevention. Participants outlined a comprehensive approach to fire prevention that stressed voluntary action through public education as well as systems of passive and active protection through engineering and code requirements. In addition, a new emphasis was placed on code enforcement to increase compliance with emerging engineering requirements. Typical fire risk scenarios are conceptualized as causal chains (Weller et al., 2017) that are linked to

multiple contributing factors (Corcoran et al., 2011; Jennings, 2013). Viewing fire risk from the perspective of these causal chains permits broad-based preventive interventions that utilize each of the 3Es.

Three primary approaches — education, engineering, and enforcement — reflect public health concepts of primary, secondary, and tertiary prevention. They also allow incidents to be viewed in pre-event, event, and post-event phases (Haddon, 1970; Runyan, 1998). Public fire safety education (hereafter "public education") focuses on changing people's behavior. Engineering focuses on fire protection features in the built environment. Enforcement focuses on fire and building code enforcement and fire/arson investigation.

There is no requirement for instituting all of the 3Es within the local fire department (Crawford, 2012). The administration of 3E provision is a fundamental policy of the local government and affected by changing budgetary constraints. Typically, public education is the responsibility of the local fire department. In some communities, engineering and enforcement may be assigned to other bureaucratic agencies (e.g., a building commission), and fire investigations may be conducted outside of the local jurisdiction.

Regardless of the preventative benefits provided by the 3Es, public trust in the fire service places a premium on response capacity. Consistent, prompt, and capable response leads communities to view the fire department as the responder of first and last resort, regardless of the perceived emergency (Freeman, 2002; Page, 2002). These responses have expanded to include emergency medical services, hazardous materials response, technical rescue (high-angle, collapse, water), and general service calls such as flooded basements and downed trees on houses. Contemporary fire departments are all-hazards response agencies, and they provide a panoply of emergency response services that keep them in the public eye (Page, 2002; Smoke, 2004; National Fire Data Center, 2009). Fire departments' community response demand tripled between 1980 and 2013 — from approximately 11 million to 32 million incidents per year (National Fire Protection Association, n.d.). The emphasis on expanded capability and the increase in service demand make the prospect of cutting emergency response budgets a daunting challenge for fire service leaders.

Institutional Theory and Cutback Management

In his influential article, "The Science of Muddling Through," Lindblom (1959) observed that the complex nature of social problems generally results in incremental decision-making within public organizations. According to Lindblom, policy innovation is often limited to changes at the margins that emphasize the value of past knowledge and understate the potential costs of future mistakes. This incrementalism stabilizes policy over time, but it also reinforces existing behaviors and stymies the emergence of newer, more effective approaches (Bednar & Page, 2018). Because incremental decision-making rarely considers unfamiliar options, it often presents inadequate solutions to particularly difficult collective action problems (Robinson & Meier, 2006).

Fire service policies based on the expectations of our local communities could be described as *path dependent*. In essence, path dependency is a multiphase process in which present and future behaviors are increasingly locked into past behaviors (Robinson & Meier, 2006; Sydow et al., 2009; Wilson, 2013). Path dependency develops due to the costs associated with: (a) learning new behaviors versus current ingrained ones; (b) challenging established complex social institutions; (c) emerging social and financial expenditures; and (d) institutionalizing self-amplified small changes over time (Kay, 2005; Robinson & Meier, 2006; Wilson, 2013).

Public expectations may prompt fire department leadership to favor emergency response over more vigorous prevention services. Path dependence is evident in public budgeting: the services that local governments provide, the relative priority of those services, who will benefit from them, and who will pay for them (Rubin, 2010). Local politicians such as mayors and city council members oversee the intense competition for limited resources among local government agencies. These political actors, systems of rules, and past outcomes all contribute to the allocative decision-making process.

The cutback environment is highly political, creating winners and losers among program constituents. Lobbying from vested stakeholders often determines the end result. However, in a reflection on Hardin's "The Tragedy of the Commons" (1968), a high degree of uncertainty can exist for electoral outcomes. Individuals typically base their votes on personal cost-benefit calculations rather than the consequences for the community. This means that reelection-seeking officials may not have knowledge of the resulting effects of

budget cuts and will delegate the difficult task of making cuts to department administrators. These administrators must, in turn, weigh the impact that implementing these cuts may have on their own careers (Kwon et al., 2010).

Leaders normally take one of two path-dependent approaches to making budget cuts. They implement across-the-board budget cuts or ration cuts to specifically targeted agencies/services (Levine, 1978; Raudla et al., 2015). Across-the-board strategies cut equal amounts (or proportions) from all budget line items. Because sacrifice is shared, staff and services may be reduced but continue to perform. Targeted strategies impose selective budget cuts that may sacrifice specific services.

Unlike the private sector, the public sector faces long-term consequences for the adverse outcomes of cutback management. The resulting consequences may appear small at first but end up being quite significant should a highly salient event take place (e.g., a deadly fire). Cutbacks to public entities like fire departments have substantive consequences that are hard to anticipate. For this reason, we chose to study path-dependent aspects of budget cutback strategies that fire departments have implemented during severe economic conditions.

Vision 20/20 Fire Prevention Cuts Survey

To learn more about these cutback strategies, we utilized data from the *Vision 20/20 Fire Prevention Cuts (FPC) Project* [1] — a survey of fire service leaders administered during the spring of 2012. This project began in 2010 when, for months, fire marshals, fire code enforcement officials, and other fire prevention service providers conducted discussions via an electronic (information exchange) bulletin board. Discussion participants were concerned about the budget cuts to their departments' fire prevention programs caused by the Great Recession. In March 2011, a working group was created to develop a survey questionnaire that would help identify the post-recession status of fire prevention nationwide. The group consisted of eight individuals from across the United States with extensive career fire prevention experience at the national and local level. The Vision 20/20 project is supported through the U.S. Department of Homeland Security, the Assistance to Fire Fighters Fire Prevention and Safety Grant program, and the Institution of Fire Engineers U.S. Branch. No direct funding was provided for the survey, although it contributed to Vision 2020's Strategy 1 of greater advocacy for fire prevention.[2]

The FPC survey represents a nonprobability convenience sampling strategy. As such, the survey is not representative of the whole population of fire prevention providers or fire departments in general. Results are not generalizable to the population of fire departments (Johnson & Reynolds, 2012), but these data represent an initial step toward better understanding the balance between fire response and 3E services when budgets are tight.

The sampling method for the survey was based strictly on ready access to contact information. At the time of the survey, there were approximately 30,170 fire departments in the United States (United States Fire Administration, 2010). However, no comprehensive index of departments and contact information existed from which to gather information on the greater population for a random sample study. The working group decided the most feasible approach to sampling was to contact potential respondents through the existing Prevention Advocacy Resources and Data Exchange (PARADE) and National Fire and Life Safety Educators (NFLSE) electronic bulletin boards.

It should be noted that participants join these bulletin boards on an individual basis, not through their organization or department. At the time of the survey, PARADE had 937 registered members, and NFLSE had 451 registered members. Because both boards screened their participants, we were reasonably assured that the respondents were associated with fire prevention services.

Introductory and reminder emails were sent to all 1,388 registered participants. Of these, 1,321 survey starts were returned for an exceedingly high 95.2% response rate. The respondents represented a host of different organizations within the private and public sectors: 91% of respondents came from local fire departments ($n = 1,198$), 1.7% came from local building departments ($n = 23$), and 3.3% came from other local departments ($n = 44$). The remaining survey responses came from federal, state, and private entities ($n = 56$).[3] Because this study focused on the local government environment, respondents from federal, state, and private actors were removed from the final sample. Our final study sample consisted of 1,200 respondents

who completed each question on 3E service provision and organization type. This final sample represented 94.9% of the original local government survey respondents. Again, as a convenience sample, it was not necessarily representative of the general firefighting population's cutback behavior during the 2008 global financial crisis.

3E Service Provision

Development of a classification of phenomena is the "most important and basic step" of scientific study (Carper & Snizek, 1980, p. 65). No systematic classification of fire prevention service provision could be found within the existing literature, so our initial task was to create a 3E Index to represent this provision in our convenience sample. The index references five items from the FPC survey (see **Table 1**) that asked which agency provided the specific 3E service for the local jurisdiction.

Table 1

FPC Survey Questions in the 3E Index

Item	FPC Question	Sample (n)	Sample Min.	Sample Max.	Sample Std. Dev.
1	Who provides plan review?	1200	1	5	0.88
	Local fire department	815			
	Local building department	258			
	Other local department	70			
	Service is contracted out	23			
	Service not provided	34			
2	Who inspects new construction?	1200	1	5	0.81
	Local fire department	864			
	Local building department	225			
	Other local department	64			
	Service is contracted out	15			
	Service not provided	32			
3	Who inspects existing buildings?	1200	1	4	0.77
	Local fire department	966			
	Local building department	113			
	Other local department	69			
	Service not provided	52			
4	Who provides public education?	1200	1	4	0.53
	Local fire department	1139			
	Local building department	11			
	Other local department	23			
	Service not provided	27			
5	Who provides fire/arson investigation?	1200	1	4	1.18
	Local fire department	889			
	Local building department	11			
	Other local department	98			
	Other (federal, state, private)	202			

Note. The study sample had 1200 observations after listwise deletion of non-responses and response items "Other – please specify" and "Not applicable."

The response sets provided a series of options/locations for each 3E service[4] that were recoded into an ordinal value (see **Table 2**). We recoded and ranked the provision of each 3E service on a scale between 4 and 1. If the local fire department provided the service, it was coded as a 4. If another local department provided the service, it was coded as a 3. Services contracted out, including those provided by another level of government, were coded as a 2, and services not provided were coded as a 1.

Table 2

Calculation of the 3E Index

Item	FPC Question	Response Item	Valuation
1	Who provides plan review?	Local Fire Department	4
		Local Building Department	3
		Other Local Department	3
		Contracted Out	2
		Not Provided	1
2	Who provides new construction inspections?	Local Fire Department	4
		Local Building Department	3
		Other Local Department	3
		Contracted Out	2
		Not Provided	1
3	Who provides existing building inspections?	Local Fire Department	4
		Local Building Department	3
		Other Local Department	3
		Not Provided	1
4	Who provides public education services?	Local Fire Department	4
		Local Building Department	3
		Other Local Department	3
		Not Provided	1
5	Who provides fire/arson investigation?	Local Fire Department	4
		Local Building Department	3
		Other Local Department	3
		Other (Fed. St. Private)	2

Note. The five items ask who provides the particular 3E fire prevention service. Numeric values were assigned on the relative location of service provision to the fire department. Higher values indicate placement of the service within the domain of the fire department, but do not presume that delivery is inherently greater/better.

The final 3E Index calculation takes the mean value across each of the five different items to create an aggregate service score for each respondent. The index provides an interval level variable for measuring the level and distribution of fire prevention services in the respondents' communities. Lower 3E Index scores imply that fewer services are provided by a greater number of service providers. Higher index values indicate more services are provided with greater levels of consolidation within the local fire department.

Lower 3E Index scores may indicate an increased vulnerability of 3E services to budget cuts. For instance, Rubin (2010) suggests that other city departments may not place the same budgetary priority on fire prevention as they do on the fire department. Building departments often operate as self-supporting enterprise funds, so 3E services that do not generate revenue, such as public education, are at a much higher risk of elimination during economic downturns. On the other hand, departments with fewer services may be less vulnerable because additional cuts are unlikely to generate significant savings. Furthermore, it becomes

difficult to cut funding specific to fire prevention when the emergency response force is also responsible for building inspections and/or other services. During times of cutback management, departments with higher scores often have a greater opportunity to engage in smoothing strategies such as the transfer of 3E service responsibility.

We began with observations (see **Figure 1**) about the aggregate 3E Index in relation to community size. The initial evidence suggested a great deal of path dependency in the provision of 3E services because we tend to find a lack of variation within the sample of respondents. Respondents from larger communities (i.e., more than 25,000 inhabitants) most often indicated that 3E services were provided only through the local fire department. The categorical mean values were all at the maximum 4.0 value of department responsibility. We only found substantive levels of variation for respondents from the smallest communities (i.e., fewer than 10,000 inhabitants) where fire prevention services were assigned to other entities or not provided at all. We also observed a transition point for respondents with populations greater than 50,000 where 3E delivery schemes became remarkably uniform. These relationships were likely related to variance in department type, and we present that type of variance in **Figure 2**.

Figure 1

The 3E Index Versus Community Population
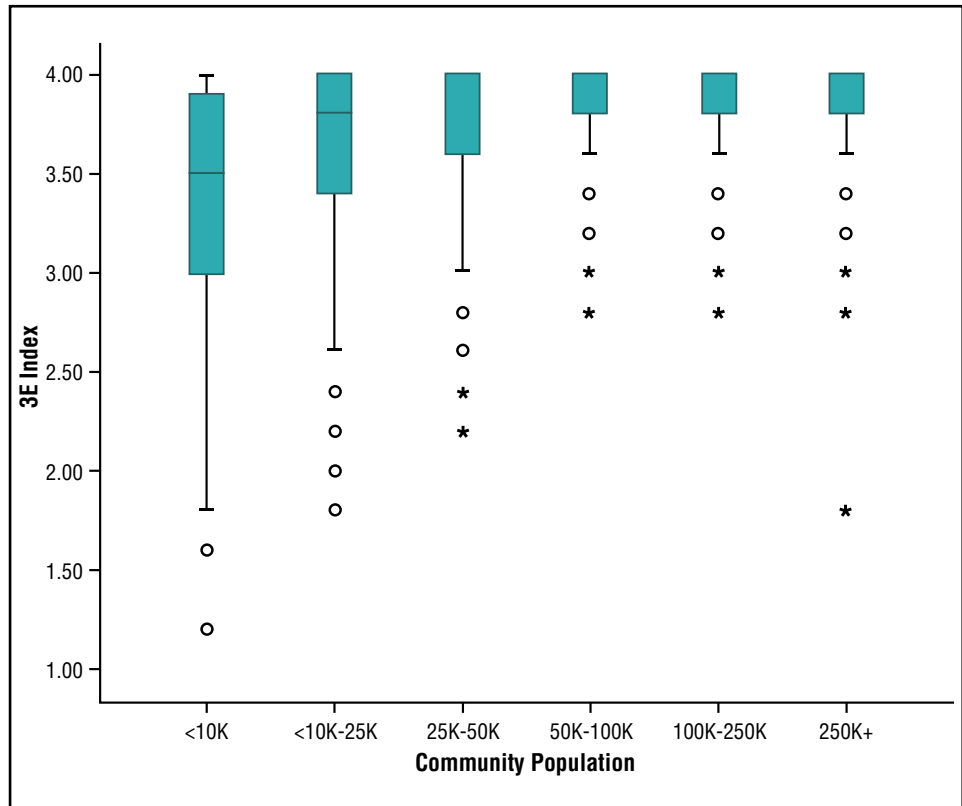
Note. Results are from a convenience sample of local government survey respondents answering all five 3E service questions. A score of 1 = service is not provided, 2 = service is contracted out, 3 = service is provided by other local department, and 4 = service is provided by local fire department. *n* = 1200. Confidence interval = 95%.

To present more meaningful levels of variance we disaggregated the different 3E services and presented them versus department type (see Figure 2).[5] In this plot, we were better able to distinguish systematic differences in the provision strategies. Initially, we observed that responsibilities for fire service public education were almost always conducted by the local fire department. Respondents from each department type indicated that education was a departmental responsibility. Despite scarce levels of resources, rural communities with volunteer departments typically were responsible for public education efforts.

Respondents from volunteer and mostly volunteer departments indicated that plan review, building inspections (both new construction and existing), and fire investigations were the services most likely to be assigned to organizations outside the local fire department. This external provision substantively declined in mostly career departments. Participants from large communities with career departments answered that fire/arson investigation – followed by plan review and inspection of new construction – were the most commonly outsourced prevention services.

As departments transition from all-volunteer to all-career organizations, more 3E services are consolidated under the local fire department. This trend, evident throughout the service categories, was found in the decreasing range of the confidence intervals of respondents from all-career departments. Figure 2 suggests a statistically significant break in the confidence intervals between mostly volunteer and mostly

career departments. This consolidation of responsibility for 3E services suggests that a critical mass of career personnel enables departments to cover the range of fire prevention services. Although the mixture of provided services stayed mostly the same, variance was visibly constricted for all-career departments.

Figure 2

3E Service Components Versus Fire Department Type
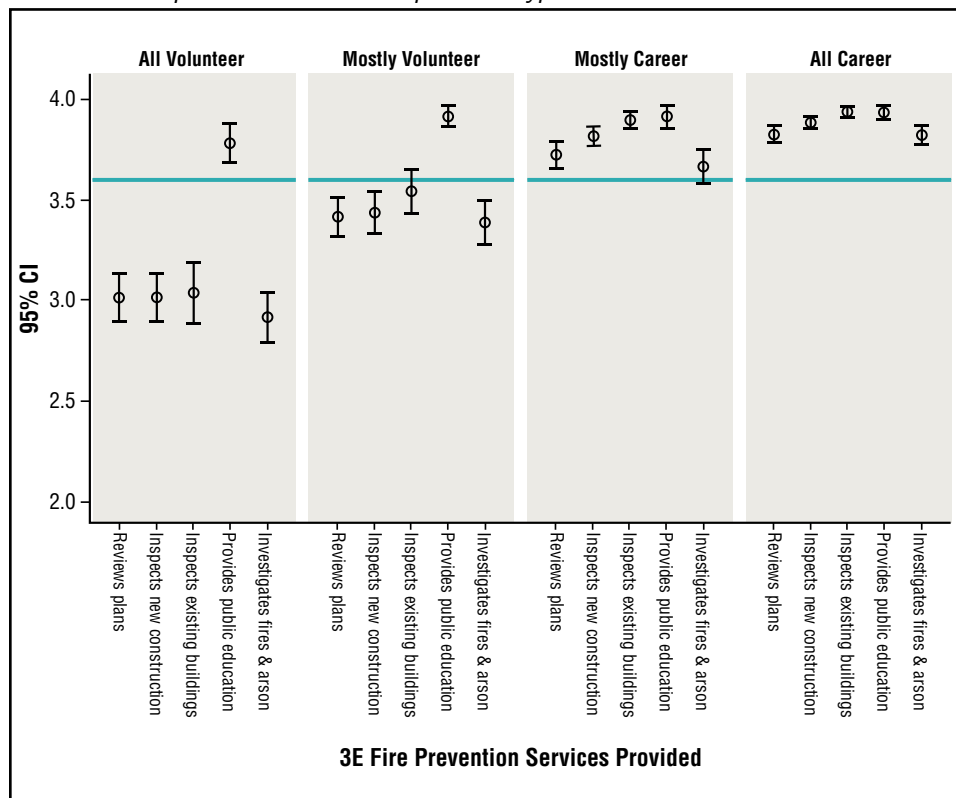
Note. Results are from a convenience sample of local government survey respondents. A score of 1 = service is not provided, 2 = service is contracted out, 3 = service is provided by other local department, and 4 = service is provided by local fire department. n = 1200. Confidence interval = 95%. The reference line indicates the combined mean (3.59) of all services provided across all respondents.

This may indicate a remarkable amount of uniformity (and potential path dependency) in the provision of 3E services by our largest fire departments.

Department type appeared to have little effect on the provision of public education. We observed no evidence of a statistically significant difference across the four groups of fire departments shown in Figure 2 and anticipate several explanations for this phenomenon. Fire service public education is a less well-defined concept compared to the other 3E services. Although NFPA 1035 (National Fire Protection Association, 2015) does publish guidance on requirements, there is little regulation of the provision of fire public education services.

Opportunities to educate the public range from informal community events to programs with systematic and structured curricula.

The NFPA, FEMA, and several insurance companies provide free public education materials that minimize costs for smaller communities most often represented by volunteer firefighters. According to most respondents in the sample, public education is the responsibility of the local fire department. However, we expect that the structure of provision may differ considerably across department types.

Understanding Cuts to 3E Services

To evaluate how the provision of 3E services was affected by substantial budgetary constraints, we ran an initial set of models that predicted whether budget cuts were made to fire prevention programs in respondents' departments. The dependent variable in these models was a dichotomous response item: "Has your organization made cuts to fire prevention services in the last two years?" Variance in this dichotomous variable was evaluated with a Maximum Likelihood Estimation (MLE) of a logit model (Aldrich & Nelson, 1984). Logit models were useful in this context as they helped us associate systematic variance in a dichotomous variable (i.e., whether budget cuts occurred) with a range of independent variables of different constructs (e.g., dichotomous, ordinal, and ratio-level control variables). We could also express estimated values in predicted probabilities (Liao, 1994), making the strategy useful in terms of interpretation.

Table 3 presents results from two models: one with the combined 3E Index (left side of table) and one disaggregated by 3E services (right side of table). Initially, we observed that the likelihood of cuts was clearly a function of departmental characteristics. Both staffing and type of department[6] significantly affected the

likelihood of 3E budget cuts. Respondents from the largest all-career departments were most likely to report fire prevention cutbacks during the Great Recession. Both coefficients were positive (β = .17 for total staffing and β = .30 for department type) and significant at a high confidence interval ($p < .01$), suggesting that the more career-oriented a department was, the more likely its 3E services would face budgetary constraints.

Table 3

Logit Estimates of the Likelihood of Fire Prevention Budget Cuts

Control Variable	Index			Individual Services		
	β	(s.e.)	p	β	(s.e.)	p
Total Staffing	.17	.06	.01	.18	.06	.01
Department Type	.30	.09	.00	.28	.09	.00
3E Index	-.26	.25	.28			
Plan Review				-.39	.19	.04
Inspection – New				.10	.25	.68
Inspection - Existing				.07	.22	.75
Public Education				-.32	.18	.08
Fire/Arson Investigation				.19	.12	.12
Constant	-.54	.84	.52	-.09	.95	.92
Observations	827			827		
-2 Log Likelihood	1115.86			1106.44		
Chi-square	30.59			40.02		
P-value	.00			.00		
AIC	1.36			1.36		
PRE	18.0			17.0		

Note. Budget outlook is a dichotomous variable (i.e., Has your organization made cuts to fire prevention services in the last two years?) with values: 0 = no cuts, 1 = budget cuts. The control variables tested are ordinal variables. Total Staffing: 1 = <24, 2 = 25-49, 3 = 50-99, 4 = 100-250, 5 = 250+. Department Type: 1 = All Volunteer, 2 = Mostly Volunteer, 3 = Mostly Career, 4 = All Career. 3E Services Provided (Plan Review, New Construction Inspection, Existing Building Inspection, Public Education, Fire/Arson Investigation): 1 = service is not provided, 2 = service is contracted out, 3 = service is provided by other local department, 4 = service is provided by local fire department.

Predicted probabilities for 3E budget cuts (see **Table 4**) showed a consistent and moderate-sized effect versus departmental staffing. Departments with staffs of fewer than 24 people had a 0.41 probability of a fire prevention cut. Departments with more than 100 people on staff were more likely than not to have a fire prevention cut (i.e., 0.54), and the largest departments exhibited a 0.58 likelihood of a cut. The same positive relationship was found versus department type. All-career departments were more likely than not (i.e., 0.56) to have a 3E budget cut whereas the likelihood for all other types was less than 0.50. In conclusion, the citizens in large urban areas that supported large, all-career fire departments were more likely to bear the effects of potential cuts to fire prevention services.

The combined 3E Index shown in the model on the left side of Table 3 was not significant ($p =.28$). This finding suggested that the general consolidation of 3E services within a department did not affect the reported likelihood of a budget cut. However, one relationship in the disaggregated, individual fire prevention services model, shown on the right side of Table 3, was statistically significant. This finding suggested that departments with particular preventive services might be more resistant to budget cuts than others without them. The parameter controlling for departments with plan review was negative (β = -.39) and statistically significant ($p < .05$). This result indicated that the departments covering plan review responsibilities might have had additional fee-service revenue to help forestall broader cuts to fire prevention units. Predicted probabilities (see Table 4) suggested that departments outsourcing plan review services were more likely to experience fire prevention cuts (0.66) than departments that retained control over plan review (0.48).

Table 4

Predicted Probabilities of Fire Prevention Budget Cuts

	Probability Value
Departmental Staffing	
> 250	.58
100 – 250	.54
50 – 99	.49
25 – 49	.45
< 24	.41
Department Type	
All Career	.56
Mostly Career	.48
Mostly Volunteer	.41
All Volunteer	.34
Plan Review Responsibility	
Contracted Out	.66
Other Local Department	.57
Local Fire Department	.48

Note. Probabilities calculated with all other independent variables set to their mean values. Departmental staffing and department type reference the first model specification in Table 3 that includes the 3E Index. Plan review responsibility uses the second model specification in Table 3.

The remaining prevention services shown on the right side of Table 3 were not significant at the traditional confidence interval ($p < .05$). We did find some marginal strength related to fire/arson investigation ($p = .12$),[7] but this variable's relationship to budget cuts was better understood within the analysis of subsequent models. Neither new nor existing building inspection services were systematically related to respondents' reporting of fire prevention cuts.

Predicting Cuts to Fire Prevention Personnel

According to extant cutback management literature (Scorsone & Plerhoples, 2010), local government managers normally choose to cut personnel when faced with budget shortfalls. Personnel cuts done through furloughs or layoffs can close shortfalls quickly because employee compensation makes up the bulk of local government expenditures. All personnel cuts have long-term consequences for organizations, including an increased workload for the remaining employees, decreased overall productivity, and sinking morale (Berne & Stiefel, 1993; Olson et al., 2004). Most importantly, personnel cuts frequently lead to the loss of the organization's most talented and resourceful employees (Cayer, 1986). Employees are the institutional memory of an organization. They have extensive knowledge of what customers expect and how to provide services that meet those expectations. After personnel cuts, an organization tends to be less effective and efficient.

To better understand the status of fire prevention personnel during the Great Recession, we present two additional models (shown on the left side of **Table 5**). These models explain survey responses about fire prevention personnel cuts. The dependent variable in these models was the response item: "Were personnel cut from the fire prevention work unit(s)?" As in Table 3, these responses were evaluated with logit models controlling for the aggregate and disaggregated individual 3E services. Again, we found positive and significant relationships in the variables for total staffing ($\beta = .38$; $p < .001$) and department types ($\beta = .50$; $p < .001$). After controlling for these two factors, we found some marginal evidence that consolidation of fire prevention services within local departments might be negatively related to reductions in the number of fire prevention personnel. The associated parameter controlling for the aggregate 3E Index was negative and just missed the $p < .05$ confidence interval with a more lenient one-tailed test.

This borderline result for the aggregate index could suggest that more robust fire prevention programs are more resistant to personnel cuts. For instance, established departments in large communities should have prevention program responsibilities that are clearly delineated and, to some extent, entrenched. When resource scarcity is shared among all subunits, efforts to realign fire prevention services can meet structural resistance (i.e., the fire prevention units are stakeholders that can make effective cases for fire prevention efforts). To better assess whether comprehensive fire prevention programs demonstrate some resistance to personnel cuts, we disaggregated the prevention services within a second model specification as shown on the left side of Table 5.

The disaggregate results pointed to the effects of fee-service revenue within the observed resistance to prevention personnel cuts. The parameter for plan review was both negative ($\beta = -.48$) and statistically significant ($p < .05$). Because plan review had the added benefit of being a potential revenue generator, it seemed to offer a better explanation than general structural resistance. Departments that bring revenue

Table 5

Logit Estimates of the Likelihood of Fire Prevention Personnel Cuts and Compensatory Action

| | Fire Prevention Personnel Cuts | | | | | | Compensatory Action | | | | | |
| | 3E Index | | | Individual Services | | | 3E Index | | | Individual Services | | |
Control Variable	β	(s.e.)	p	β	(s.e.)	p	β	(s.e.)	p	β	(s.e.)	p
Total Staffing	.38	.07	.00	.38	.07	.00	.01	.06	.92	.01	.06	.94
Department Type	.50	.10	.00	.46	.11	.00	-.03	.08	.69	-.04	.07	.61
3E Index	-.44	.29	.13				.73	.19	.00			
Plan Review				-.48	.21	.02				.06	.15	.70
Inspection - New				-.12	.28	.66				-.16	.18	.36
Inspection - Existing				.56	.31	.07				.48	.16	.00
Public Education				-.58	.21	.01				.17	.17	.30
Fire/Arson Investigation				.24	.15	.11				.25	.10	.01
Constant	-.20	1.00	.05	-2.00	1.23	.10	-3.38	.62	.00	-3.66	.78	.00
Observations	812			812			1148			1148		
-2 Log Likelihood	954.16			935.79			1421.77			1412.77		
Chi-square	81.38			99.74			21.48			30.65		
P-value	.000			.000			.000			.000		
AIC	1.18			1.17			1.25			1.24		
PRE	10.0			12.9			.00			.00		

Note. Fire prevention personnel cuts (i.e., Were personnel cut from the fire prevention work unit(s)?) is a dichotomous dependent variable: 0 = no personnel cuts, 1 = personnel cuts. In the second two models for compensatory action (i.e., Did your department take steps to compensate for fire prevention activity cutbacks?), the dichotomous dependent variable is: 0 = no compensatory action taken, 1 = compensatory action taken. The tested control variables are ordinal variables. Total Staffing: 1 = <24, 2 = 25-49, 3 = 50-99, 4 = 100-250, 5 = 250+. Department Type: 1 = All Volunteer, 2 = Mostly Volunteer, 3 = Mostly Career, 4 = All Career. 3E Services Provided (Plan Review, New Construction Inspection, Existing Building Inspection, Public Education, Fire/Arson Investigation): 1 = service is not provided, 2 = service is contracted out, 3 = service is provided by other local department, 4 = service is provided by local fire department.

generators like plan review into the unit may be more resistant to personnel cuts in times of economic peril. The fee revenue helps to preserve jobs in other fire prevention services, such as inspections, education, and investigation.

We found other supporting evidence in the model results. Looking at the control for existing building inspections, the coefficient was positive (β = .56) and at *p* = .07 would meet the *p* < .05 confidence interval with a one-tailed test (i.e., the result would be *p* = .04 with the single-tail test). After controlling for plan review responsibilities, the isolated effect of existing building inspections on the likelihood of personnel cuts was positive. When an opportunity for fee-service revenue did not readily exist, we observed a positive relationship between prevention service provision and the likelihood of personnel cuts. This makes sense if the path-dependent strategy is for across-the-board cuts. Without revenue generation capacity, personnel doing existing building inspection (or potential fire/arson investigation)[8] may be subject to a reduction in force consistent with other department personnel. Existing building inspection showed some vulnerability to personnel cuts. Fire/arson investigation showed very moderate evidence of this vulnerability (β = .24).[9]

Predicting Compensatory Actions for Fire Prevention

Personnel cuts provide immediate and, hopefully, short-term responses to economic constraints, but departments must also find ways to counter the long-term effects of cutbacks. To gain some final insights on fire prevention provision, we modeled the likelihood of compensatory actions (see right-hand columns of Table 5). The dependent variable for this section was: "Did your department take steps to compensate for fire prevention activity cutbacks?"

In the model with the aggregate 3E Index, neither department staffing (β = .01; p = .92) nor department type (β =-.03; p = .69) was related to the likelihood of compensatory actions. However, the parameter controlling for the aggregate 3E Index was statistically significant (p < .001) and had a positive parameter coefficient (β = 73). Compensatory actions were a direct function of the breadth of fire prevention services and not necessarily related to staffing size or the ratio of volunteer and career firefighters. The plot of predicted probabilities (i.e., the middle reference line which is surrounded by a 95% confidence interval) showed a moderate-sized relationship versus variance in the 3E Index (see **Figure 3**). The mean value of the 3E Index in this sample was 3.68 and it was associated with a 0.32 likelihood of compensatory action. For a completely in-house 3E prevention strategy of 4.0 on the 3E Index, the likelihood of a compensatory action increased to 0.37. This would suggest that some amount of compensatory action was taking place for approximately one-third of respondents associated with the largest departments.

Figure 3

Predicted Probabilities of Compensatory Actions Versus 3E Index
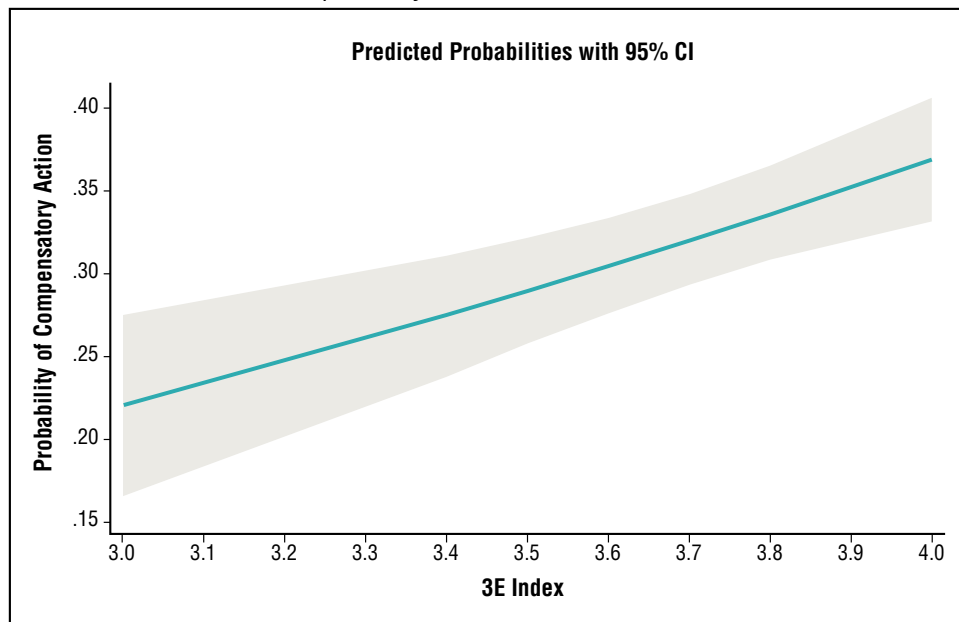
Note. Probabilities calculated with all other independent variables set to their mean values. Plot references the third model specification in Table 5 that includes the 3E Index. Mean value of the 3E Index in that model specification is 3.68 with standard deviation of .46.

The need to compensate for prevention cuts tends to be a simple function of what the department provides in the first place. Higher 3E Index scores positively influenced the odds that a department would take some form of compensatory action. This result implied that communities with robust, full-spectrum 3E service programs would try to preserve the effectiveness of these programs, even in the face of fiscal stressors. FPC respondents suggested (see **Table 6**) that these departments were implementing long-term strategies such as combining work units, intra-agency transfers of service responsibility, and general process improvements.

The 3E program goals and objectives are important to local fire department decision-makers. However, when these leaders must make cuts, they tend to target public education materials, internal training, and reference materials. Although the resulting effects of these cuts are more difficult to discern, they clearly exist.

The final model specification with the disaggregated, individual 3E services (shown in the far right column of Table 5) helps to identify the provision schemes where compensatory action is most likely. Only two of the seven control variables — existing building inspections (β = .48, p < .001) and fire/arson investigation (β = .25, p <. 01) — were statistically significant. Both variables had positive coefficients, suggesting that fire prevention units with existing building inspections and fire/arson investigation show an increased likelihood of compensatory action.

These two results seem intuitive. Responsibility for basic-level, existing building inspections can be easily transferred to emergency response units. Many departments normally assign this responsibility to front-line companies and leave the technically detailed inspections to specialists. Departments also commonly outsource fire/arson investigation with the potential for criminal involvement as the referral factor. The remaining parameters indicate that none of the other variables contributed to our understanding of compensatory actions.

Table 6

Fire Prevention Resource Cuts and Compensatory Actions

	N	% Respondents
Compensatory Actions for Fire Prevention Cuts	370	32.2%
Combined Work Units	145	12.6%
Internal Transfer of Responsibility	115	10.0%
Process Improvements	91	7.9%
Formal Discontinuation of FP Service	71	6.2%
Technological Improvements	63	5.5%
Increased Use of Community Volunteers	49	4.2%
External Transfer of Responsibility	26	2.3%
Contracted Out Specific FP Activity	13	1.1%
Other	63	5.5%
Fire Prevention Resource Cuts	592	51.1%
Public Education Materials	415	35.8%
Training for Employees	311	26.8%
Reference Materials	243	21.0%
Training for Clientele	207	17.9%
Organization and Infrastructure	176	15.2%
Other	34	2.9%

Note. Fire prevention resource cuts (i.e., Were fire prevention activity resources cut back?) is a dichotomous variable followed by a breakdown query (i.e., What types of fire prevention resources were cut back? Check all that apply). 1159 respondents completed these prompts. Compensatory actions (i.e., Did your department take steps to compensate for fire prevention activity cutbacks?) is a dichotomous variable followed by a breakdown query (i.e., Which, if any, of the following actions did your department take? Check all that apply). 1148 respondents completed these prompts.

Fire Prevention Services under Economic Constraint

Our analysis of 3E services during the Great Recession reflects an environment of path-dependent solutions for the provision of fire prevention services. The Vision 20/20 FPC survey results indicated that a substantial amount of uniformity existed in the provision of 3E services, and these services were most often the responsibility of the local fire department. The consolidation of fire prevention responsibilities under department leadership tended to occur in relatively small communities. The greatest changes in 3E provision occurred in communities with 25,000–50,000 inhabitants.

Answers from respondents in these larger communities indicated a substantial amount of uniformity in internal fire prevention provision strategies that became standardized as the percentage of career firefighters increased within the department. Mostly career and all-career departments had a very similar 3E provision structure. However, public education was almost always the responsibility of the local fire department, including in all-volunteer and mostly volunteer departments. The first component to be outsourced appeared to be fire/arson investigation, followed by plan review and new construction inspection.

We also found that the fire prevention provision structure was systematically related to the need for cutbacks. Communities that had implemented plan review within the local fire department appeared more resilient to newly emerging economic constraints. Fee-service revenue from plan review appeared to counteract the need to cut services and/or to force reductions in prevention personnel.

Thus, a stable and effective 3E provision strategy may be a function of fire service leaders' ability to bring plan review within the department. To the extent possible, this consolidation may create a more stable funding foundation for building inspection, fire investigation, and public education efforts. Without this additional support, financial hardship likely will result in path-dependent cuts to prevention personnel and/or compensatory actions such as combined work units and internal transfers.

Building inspection responsibilities may be assigned to response personnel. Budgetary constraints are likely to result in some form of adjustment to public education and internal training resources. However, public education is an area of fire prevention that can be scaled back quietly, and the consequences of cutbacks are difficult to connect to observed fire losses.

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Footnotes

[1] Like most survey projects, the FPC has some particular strengths and some inherent weaknesses. This survey uses a convenience sampling technique, so it is not representative of the general firefighting population nor can the results be generalized. However, the response rate for the FPC survey was extremely high (e.g., FPC has a 95% response rate when survey research projects are satisfied with 20%). Thus, it provides details of cutback activity within a sizeable sample of experts who clearly are concerned about the topic. One of the limiting aspects of the data is that it did not have a lot of breadth in terms of available independent variables. Our models are often limited to a couple of descriptive control strategies (e.g., staffing and department type because of inherent levels of correlation). Given the lack of hard data in this area and the terrific response rate, our strategy was to get the most out of the valuable data at hand. Along those lines, we present figures of different relationships and model results that may have limited numbers of control variables within the underlying specifications.

[2] Vision 20/20 proposes six strategies for improving fire prevention actions in the United States. Strategy 1 is to "Increase advocacy for fire prevention." Additional information can be found at http://toolkit.strategicfire.org.

[3] Respondents who selected "Other – please specify" or "Not applicable" were listwise deleted from the study sample.

[4] We designed the scale to reflect the fire department's level of control over the fire prevention service and arrange it from the most controlled situation (4), where the service is provided within the department, to those situations where the service is not provided within the local jurisdiction (1). We set the lower end of the scale at 1 to avoid mathematical problems associated with the zero point of the scale. Theoretically, we could establish lack of provision of the service as a zero point, but we chose to set it as a 1 to avoid algebraic manipulation problems such as dividing by zero. The estimated variance is the same under either scale configuration.

[5] To save print space, we do not present the 3E service components versus community size, but that plot is very similar to Figure 2. It shows a similar transition with Figure 1 where a more uniform 3E service strategy emerges for communities with more than 50,000 residents.

[6] We limited the control variable strategy to departmental staffing and department type as well as substitution of the aggregate 3E Index and individual 3E components. Staffing and department type were correlated at .41 in the sample and tended to perform better than alternative variables such as community size. The correlations between those two variables and the 3E variables were all substantially less than .70. A correlation of .70 or greater is the level at which we begin to have concerns about multicollinearity. Only one pair of variables had a correlation greater than .70. The relationship between plan review and new inspections had a pairwise correlation of .75, which was relatively mild. Thus, the effects of multicollinearity within the model specifications were within acceptable boundaries and practices.

[7] We also found a negative (β = -.32) and significant relationship (p = .08, which meets the $p < .05$ interval with a one-tailed test) with the public education prevention service. We interpreted this parameter result as a spurious relationship. While it could suggest that a department's responsibility for public education is negatively related to unit cuts, we interpreted the result in light of previously presented evidence on public education. Figure 2 showed that fire prevention education is almost always covered by the local department, so the negative parameter result found here was likely a function of volunteer and mostly volunteer departments that did not have dedicated fire prevention units to cut. Separately, we modeled whether the respondent's department was likely to have a dedicated fire prevention unit. The models showed positive and significant relationships for community population, department staffing size, and personnel type. Respondents from smaller departments with more volunteer firefighters were much less likely to have dedicated fire prevention units. The lack of units to cut within these contexts would explain this observed relationship.

As shown in Table 5, public education was also negatively and significantly associated with fire prevention personnel cuts. This relationship also appears to be an artifact of structural differences in the provision of public education between volunteer and career departments.

[8] The parameter result for the provision of fire/arson investigation was also positive and just missed the significance interval at a $p < .05$ one-tailed test. The result for compensatory action likewise suggested that these services were affected by the lack of revenue generation.

[9] A final note on the model for prevention personnel cuts is needed for the effects of public education duties. Like the model in Table 3, the parameter was both negative and significant. Like the earlier results, however, the negative relationship most likely was a latent function of department type and structural differences in public education programs between volunteer and career personnel structures.

Author Note

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