AN INQUIRY INTO FIRE SERVICE CONSOLIDATION AND THE ECONOMIES OF SCALE DEBATE: THE CENTRALIZATION VERSUS DECENTRALIZATION ARGUMENT

by

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ABSTRACT

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Addressing the current homeland security challenges requires scholars, practitioners, elected officials, and community partners working in unison to mitigate the hazards confronting first responders. Built on public choice theory, this research addressed a specific component of the emergency preparedness matrix: the most preferred fire service organizational design. The fire department organizational designs in this study included a Florida county, city, and independent special control fire district (ISFCD) that serve residents on a full-time platform. The concurrent embedded methodology used attempted to unearth which organizational design achieves economies of scale based on quarterly emergency service calls: the centralized county model or the decentralized city/ISFCD models. This study was an inquiry into the centralization versus decentralization argument, with emphases on fire service scale economies and inter-local service agreements.

Using multiple linear regression modeling accompanied by face-to-face interviews with the respective fire chiefs, this research showed that the county and ISFCD achieve scale economies over 44 quarters, fiscal years 2004-2014. Moreover, the interviews uncovered that response times were the driving factor behind instituting voluntary inter-local service agreements between the three fire departments. Other positive benefits from the service agreements include an increase in personnel and scene safety, dispatch center protocol enhancements, multi-company/jurisdictional training, overtime savings on large-scale disaster incidents, and trust building.

The implications of this research for the scholarly and practitioner community include a better understanding of the technical and allocative efficiencies within the fire service arena. Melding public choice theory with strands of inter-local service agreement literature provides policymakers and scholars with a template for uncovering the fire service production/provision narrative. Though the centralization-decentralization argument is not solved within the research scope presented, the future narrative as uncovered in the research requires a citizenry inclusion. The future public choice prescriptions regarding fire service consolidation requires not only statistical modeling, but a normative democratic ethos tone incorporating multiple stakeholders with the citizens' concerns at the forefront.

DEDICATION

This manuscript is dedicated to "my girls," Shawna, Alana, and Ayla. Without your unyielding support, patience, and love, this manuscript would not be possible. This manuscript is dedicated to Dewey and Gail Henry, may you both rest in peace, and thank you for treating me like a son. To all fire service professionals who proudly serve on the front lines every day, thank you for your dedication ensuring our local communities are protected. Lastly, to all armed service members and police officers who protect and serve and who ensure my freedom is secure so I am able to pursue my professional and scholarly endeavors, thank you!

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CHAPTER I. INTRODUCTION

The fiscal and economic crises over the 20th century, coupled with social and demographic changes, placed considerable strain on public budgets and administrative structures. To address the current decade's financial turmoil and social changes, the public administration arena, elected officials, local leaders, and intellectual leaders must enhance their understanding and skill set concerning public and regional engagement challenges across jurisdictional boundaries. The emergency management arena, as discussed by Comfort, Waugh, and Cigler (2012), requires public administration theorists and practitioners to lead the global/regional dialogue, confronting our communities as continued loss of lives and property underscores the urgency of public agencies "in making emergency management a central issue in public administration" (p. 539).

The terrorist and homeland security challenges confronting the United States, according to Caruson, MacManus, Kohen, and Watson (2005), require scholarly and practitioner involvement, coupled with multiple partner engagement across our federalist system. Solving the homeland security preparedness initiatives requires an intergovernmental system composed of federal, state, and local governments; special districts; private corporations; and non-profit agencies working together through coordinated collaborative networks and regional partnerships (Caruson et al., 2005). The need for solving homeland security preparedness initiatives, as Caruson et al. asserted, involves rectifying a fragmented federal grant system and aligning local jurisdictional

and political bodies to plan properly for effective emergency response. “In the wake of the events of 11 September 2001, homeland security represents one of the most important public policy issues that federal, state, and local officials must address” (Caruson et al., 2005, p. 144).

The public policy input of local governments and first responders is especially important as local governments oversee many emergency preparedness procedures, while first responders provide the first line of defense in protecting communities from terrorism, disasters, and crises. This, coupled with (Caruson, et al., 2005, p. 146) noting that “the primary impetus for more regional solutions to homeland security policy mandates has come from first responders,” makes this study even more important in the political debate focusing on approaches to terrorism preparedness.

Solving germane policy issues related to today’s complex emergency management arena is extremely important for public administrators in this area. Specifically, the complex policy issues affecting fire service officials with emphases on whether fire service organizations have the correct structure to meet the growing demands for first responder services, and which approach to protecting the country is appropriate, that is, a hierarchical or multi-jurisdictional structure (Wise, 2002).

The right organizational structure, according to Wikstrom (1978), is difficult to define, as metropolitan jurisdictions are complex entities with various political power bases and government designs. One approach, the centralized perspective, calls for a consolidated government structure, while the other approach includes a fragmented/decentralized government design spanning multiple jurisdictional boundaries (Feiock, 2004). Answering the organizing approach question, hierarchy or network,

revolves around Wise's (2002) notion that "requisites for combating terrorism are in the process of discovery; the organizations that must be coordinated and for what purpose are the subject of deliberation and debate and will shift…" (p. 141).

To advance Wise's (2002) assertion that a template for protecting the homeland is in a stage of discovery, this study's main purpose was to unearth the most preferred fire service organizational design in a Florida county encompassing a centralized consolidated fire/EMS structure, a city fire department, and a decentralized independent special fire control district (ISFCD). This study was an inquiry into the centralization versus decentralization argument with emphases on fire service scale economies and inter-local service agreements (ISAs).

Background

The outstanding debt of the U.S. Treasury equals approximately $12.044 billion, or about $40,000 per resident within the United States. The state and local government debts add another $2,551 billion to the aforementioned total, for an outstanding debt level of $16,595 billion (Robbins & Simonsen, 2012). The reason for increasing debt levels emanates from the compounding effects of sustained annual federal deficits in the trillions of dollars - recent estimates place the fiscal year 2011 ending deficit at $1.3 trillion. The long-term deficit spending on economic indicators lacks consensus due to market uncertainty; however, if economic conditions remain constant, in conjunction with annual deficit spending, the present value of public services enjoyed today means increased taxes and decreased spending levels at a future date (Robbins & Simonsen, 2012).

To decrease the tax burden (i.e., government claims on economic output) on citizens, economic growth must outpace debt expansion and government spending. "If spending continues to exceed revenue and economic growth, then debt claims an ever-larger share of economic output. State government debts and deferred obligations have reached such levels that a debate has ensued about the potential to repudiate these debts through bankruptcy" (Robbins & Simonsen, 2012, p. 499). The major concern is excessive debts levels with governments not in a stable position to manage them and still deliver essential public services to its citizenry. In essence, state and local government capital projects and infrastructure financing mechanisms become risky investment endeavors for the capital markets to absorb, leaving many projects unfunded (Robbins & Simonsen, 2012).

To combat the current fiscal and economic crises, government entities around the country are debating the need to merge public services, departments, and entire agencies in an effort to reduce costs. In Pennsylvania, the governor proposed consolidating the state's 501 school districts into as many as 100, and New Jersey's governor proposed to merge the smallest school districts with municipal governments. In San Diego, the president of the city council suggested to merge the "cash-strapped" city with San Diego County. In Indiana, the governor and mayor of the state's largest city are attempting to alter the 1,008 townships, including the nine elected townships that govern the fire rescue and emergency service agencies (Dougherty & Merrick, 2009).

While government leaders profess mergers and streamlining procedures to save taxpayer's dollars and increase public service delivery, citizens often do not support the consolidation process. Residents fear merging government entities into a single regional

provider promotes declining property valuations in their respective community, coupled with loss of quality public services and democratic control in the governing process. Residents living in affluent communities with higher property valuations fear their tax dollars might subsidize the less-affluent jurisdictions. From this, it means that communities with healthy finances are less willing to bail out failing neighboring cities (Dougherty & Merrick, 2009).

Mildred Warner (2011), director of graduate studies at Cornell University's Department of City and Regional Planning, purports the fiscal crisis is prompting a new kind of conversation among city/county officials, public administration leaders, and residents. Barnes (2010) has opined the coming decade provides fertile ground for continuing economic and fiscal turmoil, and the conversations to handle policy and program issues need to include the elected, managerial, and intellectual leaders. These individuals must increase their learning capacities and skill set regarding public and regional engagement across jurisdictional boundaries. Lack of the latter skill set during the 20th century conversation led to a deficit governance model enveloped within a dysfunctional democratic and regional dialogue (Barnes, 2010).

To overcome the deficit governance model, specifically in relation to economic modeling and change, Barnes (2010) addressed several key issues that public administrators may confront in deciding the appropriate sector that controls the main elements of the economy – the public sector or the market economy. These include: (a) expansion of the public-private partnerships and the accompanying ideological battles that demand decisive decision-making, (b) circumvention of national borders to enhance the local economies in the wake of a global marketplace, (c) competition inside political

boundaries to heighten economic development and tax bases, (d) continuing exploration of selling public facilities and privatizing public services, and (e) the increasing foreclosure dilemma. All of the above will bring greater awareness to local government practices such as building code enforcement, property tax credits, and service agreements with banking institutions (Barnes, 2010).

In addition to the aforementioned policy challenges confronting the 21st century public administration arena, the county's fiscal structure is most likely going to undergo extensive change coupled with an organizational restructuring (Benton et al., 2008). Possible scenarios include changing jurisdictional relationships and their respective tax bases within governing regions by forming special districts, revenue, and tax-base sharing between regional governments, and transferring power between government entities (e.g., city-county consolidations and inter-local agreements). County governments are emerging as role models in respect to regional service providers and functional service consolidation specialists – especially in public safety and solid waste management arenas (Benton et al., 2008).

The county government model as regional service provider is one school of thought that developed under the progressive American metropolis. This monocentric position views local government fragmentation (i.e., polycentrists) as inefficient, producing diseconomies of scale and excessive externalities. The single regional government, through consolidation of services, produces economies of scale; adequate geographic boundaries; and revenue collection mechanisms that champion equity and even distribution, and provides greater accountability to the citizenry (Janiskee, 2004).

The second main school of thought that materialized under the modern metropolitan area consists of the polycentric view. Built on the theoretical foundations of public choice theory, polycentrists believe that local political fragmentation promotes government competition, produces higher levels of public service, achieves economies of scale, and "…is beneficial to the health of the American regime" (Janiskee, 2004, p. 90). Polycentrists argue that local government consolidation under the monocentric structure creates diseconomies of scale, removes the right of self-government through abandoning local political schematics, and "will only make a bad situation worse" (Janiskee, 2004, p. 90).

Problem Statement

For over a century, scholars from two sides – the centralized advocates versus the decentralized supporters – have "…proposed contrasting visions of how the local public sector should be organized" (Jimenez & Hendrick, 2010, p. 259). The metropolitan government reformers advocate greater efficiencies and service delivery responsiveness increase with consolidation of several government entities. The public choice scholars of urban government, as Wikstrom (1978) believes, "…are correct in their contention that the presence of a large number of general-purpose governments in the metropolis, each with its own package of private goods and public services" (p. 6) allows competitive forces into local communities so the citizen-consumer may best choose the service provisions that meet their individual needs. The public choice urban government perspective counters the consolidation approach with the assertion that only a fragmented government system bring economies of scale and better service delivery to given

jurisdictional boundaries as market-like competition allows consumers to choose the level and type of public goods/services to purchase (Jimenez & Hendrick, 2010).

Furthering the public service provision debate, Benton et al. (2008) asserted that the role of county government in today's landscape includes simultaneous operations as traditional, local, and regional government organizations; meaning, local county governments often provide city-like and urban public services (e.g., public works, road and bridge, and fire) to unincorporated and incorporated portions of a respective county. Moreover, there are numerous public service challenges confronting this multi-purpose governmental unit, specifically, the homeland security challenge. Furthermore, the random nature and destructive tone of the homeland security challenge is forcing local government entities to re-prioritize emergency responder service levels and annual budget appropriations (Benton et al., 2008). The September 11, 2001 events have had a severe impact on county and local government financing appropriations, and (Benton, et al., 2008) note, that this additional threat to our homeland adds to the already existing financial challenges of providing proper emergency response service levels.

Benton et al. (2008) draws our attention to the fact that complex homeland security challenges highlight the lack of a common model for county/city government officials to utilize with respect to emergency preparedness and first responder functions while engaging in joint operational planning. Some government organizations utilize the law enforcement division as the main branch to coordinate homeland security tactical efforts; others use law enforcement and emergency management branches, while other local governments use fire departments. These fragmented approaches may cause duplication in service program coordination and raise program effectiveness and

efficiency concerns; there also is the issue of a proper return on the public monies expended for homeland protection (Benton et al., 2008).

The same fragmented approaches and lack of fire service coordinated efforts, according to Hale (2010), are prompting a Collier County, Florida citizen advocacy group and the Collier County Republican Club to push local county commissioners to answer the economies of scale issue concerning independent fire districts and municipal fire departments within the county borders. As McDavid (2002) stated, proponents of increasing the service producer size advocate that economies of scale are achieved resulting in a lower average unit-cost of service production. Addressing the economies of scale debate, Hale (2010) noted the Collier County consolidation dialogue includes declining taxable values, declining house values, and fire district budget reductions.

The importance of these issues is noted in the following example. In response to fire department/district budget reductions, Jacob (2008) reported the San Diego County Board of Supervisors is promoting cost savings and efficiencies with the consolidation of numerous rural fire agencies. The county expended $15.5 million to consolidate rural fire agencies, approximately 50 stations throughout the unincorporated area totaling more than 1.5 million acres (Jacob, 2008). In addition, the county funded $7 million for 30 new fire engines, water tankers, and other emergency vehicles designed for rural terrain. Using Orange County California as an organizational model, the San Diego fire agency provides for regional joint authority among city, rural, and county departments (Jacob, 2008).

In November 2010, Collier County commissioners placed a question on the ballot asking residents of the independent fire districts whether they would support

consolidating "…if it created more efficient use of tax dollars" (Hale, 2010, p. 2). In a non-binding vote, more than 70% of the voters responded yes to the stated ballot question; moreover, one county commissioner went on record favoring fire district consolidation (both dependent and independent fire districts) with the county's Emergency Medical Services division (Hale, 2010).

Sørensen (2006) notes that consolidation proposals (usually) trigger emotional debates and local protests. Moreover, restructuring fragmented entities to a centralized structure "…commonly incurs prohibitive political costs" (Sorensen, 2006, p. 76). Sørensen (2006) asserted that polities undertaking governmental restructuring realize greater gains when local politicians and citizens work together through coordinated efforts to decide if integration produces a net positive gain for all parties involved. With respect to homeland security, Kettl (2003) indicated that government entities undertaking organization restructuring require contingent coordination among numerous stakeholders – a delicate balance of political and administrative leadership while ensuring the safety of American citizens.

Kettl (2003) believes solving the homeland security puzzle is a function of diagnosing the contingent coordination concerns, coupled with diagnosing its failures. There is a plethora of public administration theory concerning coordination; however, what is lacking is a harmonizing blend of competing and divergent policy views into a single strategic cooperative structure. The existing public administration theory, as Kettl (2003) opined, provides a solid underpinning for homeland security coordination, noting also that it "contains a large number of important holes" (Kettl, 2003, p. 254). There is no one theory or a combination of leading theories that can plug the coordination dilemma;

rather, a blend of theoretical constructs linked with existing administrative acumen provides a starting point in addressing the homeland security puzzle (Kettl, 2003).

Intellectual Merit

For the past several decades, Khademian (2010) has asserted government agencies have depended on consolidation, multi-agency layers, and small control spans as an organizing method for dealing with dynamic collective action problems. Attempting to restructure the fragmented federal emergency management arena, Congress consolidated 22 agencies into one agency called the Department of Homeland Security (DHS) (Khademian, 2010). For over two decades, the literature seemed to suggest that there is need for a flexible, decentralized, and networked approach to organizing the challenges facing first responders (Khademian, 2010). This multi-purpose approach has not been easy to achieve, and this research sought to address the organizational shortcomings. Specifically, this research explored fire service networks (i.e., vertical, horizontal, or both), ISAs, and organizational structures (i.e., consolidated or fragmented) that currently exist within a Florida county.

According to Caruson and MacManus (2011), 70% of the most expensive presidentially declared disasters have occurred in Florida. Moreover, Caruson and MacManus (2011) noted that Florida has a higher vulnerability rating than many other states regarding human-made and natural disasters. The higher than expected vulnerability status makes Florida a great research laboratory to examine interlocal relation shifts, as the state has 406 municipalities, 67 counties, and over 1,150 special government districts (Caruson & MacManus, 2011). The disaster-risk profile, plus the many governmental designs, places great demands on local first response agencies and

government officials to cultivate and nourish effective systems of intergovernmental coordination and multi-jurisdictional cooperation.

Ascertaining and analyzing local government officials' and first responders' viewpoints are critical for understanding what factors contribute to, or encumber, intergovernmental cooperation (Caruson & MacManus, 2011). Through analyzing first responder agency budgets, Comprehensive Annual Financial Reports (CAFRs), and strategic planning documents from within a Florida county, this research attempted to uncover the broader factors that contribute, deter, and influence network partnerships, consolidation, fragmentation, or development of ISAs in the fire service.

Theoretical Framework

The American government centralization/decentralization debate, according to Ostrom (1976), began in the 1780s when a system of enforceable constitutional rules coupled with limited government provided a means for citizens to oversee a new government that "was organized to deal with overlapping communities…and multiple jurisdictions" (p. 21). The current debate, as professed by Ostrom, rests on a new style of federalism, an intergovernmental relations perspective where power sharing and authority of the states and local governments rests upon the national government's supreme sovereign authority. The national government provides the ruling law, while states and local governments are subordinate authorities subject to national control. This, according to Ostrom (1976) is the crux in the debate over centralization and decentralization.

The theories of government structure guiding the homeland security domain encompass the centralization and decentralization principles (Roberts, 2008). After 9/11, Congress and the executive branch centralized domestic security functions under the

newly created the DHS. Many individuals, according to Roberts (2008), believe the former decentralized system was too fragmented and not an effective management system to handle major catastrophes. The DHS provides the hierarchical model of inter-government relations with direct oversight of protecting the homeland through technical competence and task specialization, while the states and local governments respond to the national government's policy initiatives and unfunded mandates (Roberts, 2008).

The other organizational theoretical argument, according to Roberts (2008), concerns decentralizing homeland security and emergency management structures. Using the laboratory of democracy dictum, states and local governments should compete against each other to improve performance while ensuring regional concerns are satisfied (Roberts, 2008). This localist perspective champions the public choice school that favors a fragmented system of political and jurisdictional boundaries in the production of public goods and services, allowing citizens to choose among competing jurisdictions (Jimenez & Hendrick, 2010). Theories guiding public choice, as Wise (1990) stated, are individualistic and economic based where market-like pressures develop competition among service providers, thus creating increased efficiencies while promoting greater democracy (p. 143). The public choice scholars believe a regionalized fragmented method of service delivery insures a more efficient and responsive local sector (Jimenez & Hendrick, 2010).

To determine solutions to the centralized versus decentralized system of urban government, Feiock (2007) asserted that decentralization advocates champion the public choice theory of public goods that link "intergovernmental competition to service responsiveness and efficiency" (p. 47). Public choice theorists argue that non-centralized

approaches to urban planning promotes a government and business marketplace where consumers can choose a jurisdiction based on optimal taxing structures and service provisions (Dolan, 1990). Conversely, centralization advocates prefer the regional approach to government organization as this provides an increased power base for controlling land use and development conditions that enhance economic development protocol and reduces social inequalities by addressing social, economic, and environmental externalities. The underlying assumption of this approach is centralization provides joint agency responses to inter-jurisdictional problems better than fragmented public structures (Feiock, 2007).

The fragmented organization approach, or having the citizenry choose a home location based on certain safety factors as Roberts (2008) stated, is not always possible in the emergency preparedness arena. Terrorism and disasters span multiple boundaries and are not jurisdiction specific. Citizens are not always aware of the region's emergency preparedness capabilities or first responder forces, as local agencies possess various response mechanisms (Roberts, 2008). The emergency management arena encompassing first response agencies is highly decentralized, but it is not clear if a more decentralized structure is the answer to solving the response problem. What is needed, as Roberts asserted, is a network of federal, state, and local actors working together to determine the best methods on disaster mitigation, preparedness, response, and recovery efforts, while allowing the local first response agencies certain autonomy in carrying out response efforts.

According to Caruson and MacManus (2011) the vertical (i.e., federal-state-local) and horizontal (i.e., county-city, city-city) network approach as described by Roberts

(2008) reduces in effectiveness when intergovernmental tensions such as political posturing, legal and fiscal roadblocks, and communication equipment disparities dominate the conversation. This causes the most scholarly attention to emergency management networks post 9/11 and Hurricane Katrina to revolve around voluntary ISAs. The research on ISAs concludes that transactional costs associated with bargaining, negotiating, operating, and enforcing the agreements "…are major barriers to interlocal cooperation" (Caruson & MacManus, 2011, p. 166). Even when local authorities recognize the gains for cooperating, "…they face a collective action problem in the design and implementation of collaborative agreements to institutionalize cooperation" (Caruson & MacManus, 2011, p. 166).

How the respective political body perceives/weighs these costs and benefits of cooperation while debating interlocal service arrangements or other intergovernmental collaboration mechanisms comes under the Institutional Collective Action (ICA) framework as advanced by Feiock (2007). The ICA framework encompasses the mechanisms of multilateral contracting between several stakeholders coupled with a dynamic collective action issue in which two or more government agencies act in unison to achieve gains in public service and production provisions across a larger geographical area. The ICA framework is a collaboration model that is dependent upon information and coordination costs, negotiation costs, enforcement and monitoring costs, and agency costs (Feiock, 2007).

The ICA not only considers political costs and benefits, it also entails individuals' preferences for public service provisions from a collective decision-making standpoint. To generate testable propositions, the rational choice model must delve systematically

into specific policy concerns, and also how the aforementioned address the decision-making schematic of interested parties (Feiock, 2007).

To reduce the collective action problem among local authorities, Feiock (2007) asserted that network actors need to identify opportunities for mutual gain and they must possess accurate information within the stakeholder group. Moreover, the probability of cooperation between government agencies increases if the type of good/service produces joint gains for all parties involved, and the parties share fixed geographic borders. Sharing fixed geographic borders reduces the technical costs of sharing services, potentially increasing long-term reciprocal relationships and mutual assurances that each party shares in provision of the collective good (Feiock, 2007). Lastly, communities possessing demographic, social, and economic homogeneity (e.g., similar tax bases) are more likely to negotiate fair divisions of benefits as parties share similarly starting bargaining positions, thus reducing overall transaction costs (Feiock, 2007).

In addition to the institutional rational approach of ICA, Granovetter (1985) opined that positive social networks enhance the economic relationships among jurisdictional partners. The preference among individuals or institutions to deal with others of known integrity and trustworthiness produces decreased transaction costs when constructing social networks. According to Granovetter (1985), the information costs residing from an increase in trust mechanisms provide the social network with the economic advantages of costing less, continued relationships among parties, and continued economic relations.

According to Kettl (2003), melding the theoretical frameworks together is a step in the right direction; however, the homeland security problem requires a sophisticated

approach that builds on current hierarchical and decentralized administrative structures while pulling them together as needed in appropriate response settings. The homeland security policy puzzle requires public administration theorists and public management practitioners to devise innovative and effective response systems grounded in American democratic principles with the flexibility required for the stochastic nature of emergency response (Kettl, 2003). The foundation of homeland security, as Kettl (2003) noted, is coordinating a melding of specialists, experts, and resources for identifying what administrative structure best serve our country's needs with linking the pieces together.

Polycentrist Origins

The polycentrist conceptual framework began during the 1940s and 1950s when Vincent Ostrom, while working at the University of Wyoming and with local government officials, accepted an assignment to study cattle feeding times and round-ups during the summer and winter months (Toonen, 2010). According to Toonen (2010), Ostrom used cattle as the economic unit of analysis and perceiving the brand markings as the property rights, analyzed the various governing systems with respect to the public and private ownership land arrangements. During the winter, cattle resided and fed on private land, but during the summer, cattle resided and fed on the open lands (i.e., common areas) with the cattle herding as a collective enterprise inclusive of all public and private enterprises (Toonen, 2010).

This public-private partnership utilizing the stockowners' cattle as a unit of economic analysis began the conceptualization of associating common property with the enforcement of property rights and systems of governing. This starting point began the (re)conceptualization of looking at how to coordinate bureaucratic government, public

management, and centralized control among various organizational scales (Toonen, 2010).

Following the Wyoming assignment, Toonen (2010) noted that Ostrom employed the new skill set at the University of California, Los Angeles while studying the complex array of public and private service delivery arrangements incorporating Los Angeles' water management system. The newly created system of water rights encompassed partnerships cutting across common unit river basins and metropolitan administrative sectors. The assumption employed "…was that people with a common property had no organization in sharing the one source" (Toonen, 2010, p. 195). This common pool resource concept began the discourse against the monolithic/monocentric government administration with respect to bureaucratic control and proposed the concept of systems coordination among numerous administrative units and political actors with varying organizational scales (Toonen, 2010).

As Toonen (2010) opined, the common pool resource concept began the dialogue of introducing nongovernmental agencies into the methodological scope of public service as a competing entity (i.e., industry). The metropolitan area is not only a government organization built on hierarchical maxims, but rather an economy based on local public needs – a local public economy. The common pool resource methodology envelops principles of self-regulation, state and nonstate market institutional actors, decision-making processes concerned with collective choice, and public intervention (Toonen, 2010). As McGinnis and Ostrom (2012) noted, market-like institutional mechanisms are a form of public choice, where the public administration arena is not restricted to the

public official's behavior; rather, the focus includes an informed citizenry making decisions to enhance their welfare.

In building the market-like institutional mechanisms into the public acumen, Ostrom and Ostrom (1965) purported that basic maxims within modern economic thought revolve around the notion that organization structures and production methods vary, dependent upon the product's nature and production mechanism. The similarities used in production technologies of a given product lead to an identification of the various organizational entities concerned with said production, manufacturing, distribution, and utilization of goods as being specific to a certain industry. Organizational units within a similar industrial arena "…share a common body of information and knowledge about the nature of products, their production, and their uses. Intelligent decisions, whether by a producer, a distributor, or consumer in the same industry, require access to a similar body of knowledge" (Ostrom & Ostrom, 1965, p. 139).

Applying the industry concept to the public sector provides a useful mechanism for identifying production activity areas encompassing interrelationships across several government agencies and production units concerned with the "…provision of similar public services" (Ostrom & Ostrom, 1965, p. 140). The American educational system may be conceptualized as an industry composed of several interrelated organizations spanning the public and private domains from kindergarten through high school, universities, and private professional training institutions. The stated educational agencies produce a similar activity set – educational advancement – subject to commonalities in a core knowledge base, and using similar facilities and production techniques (Ostrom & Ostrom, 1965).

The industry analogy, as Ostrom and Ostrom (1965) asserted, is applicable to the provision of police services as provided through an organizational arrangement of local, state, and national agencies. The intergovernmental relationships utilized in police protection share a common body of knowledge and production methods in attempting to abate crime activity. The need to achieve similar objectives, coupled with optimal outcomes in the provision of police services, is attainable through various organizational mechanisms (i.e., levels of scale) and technological advancements. Ostrom and Ostrom (1965) purported that the aforementioned industry concept is applicable to any public service entity employing similar production technologies while focusing on controlling a given set of outcome events, and the systematic analysis is amenable to production methods performed by competing entities within a single public industry (e.g., fire, police, and water distribution. However, as Ostrom and Ostrom (1965) noted, boundary issues are a potential concern within the public industry concept, as certain conduct can influence particular production outcomes due to multiple agencies working closely together.

The industry concept and intergovernmental relationship ideology introduced the coproduction concept of public services as a means of increasing efficiency and effectiveness within local government. Coproduction within the public service delivery framework occurs when the consumer producer (i.e., citizen using a public service) and regular producer (i.e., service provider) equalize economic considerations in production of a given service. The equalization point for this relationship is dependent upon technology, economics, and institutional arrangements as these variables influence the

mix of consumer and regular producers' activities in a given environment (Parks et al., 1981).

Various institutional arrangements through either market intervention or alternative provision methods are needed to apportion the appropriate mix of supply cost and benefits while constraining consumer demand inputs. Where several substitution methods are available in relation to public service production functions, pricing mechanisms are one option to achieve an efficient mix of goods or to negate combining services when inefficiencies exist; however, "[t]he key to efficiency in market arrangements is the capacity of consumers to choose the price and service mix they prefer" (Parks et al., 1981, p. 1006).

Toonen (2010) purported that the concepts of institutional analysis, coproduction, and service coproducers built the foundation for the public service industry framework. This framework relies on market-like user networks to provide and produce public goods and services to the respective communities. In an effort to make the social sciences more scientific and responsive to the consumers' service demands, the public service industry framework provides the overarching vision of the polycentric metropolitan government. As an alternative to the monocentric, single-purpose consolidated metropolitan government structure, the polycentric political system consists of multiple federal and state governmental agencies, counties, cities, and special district jurisdictions that govern within a specified metropolitan region (Ostrom, Tiebout, & Warren, 1961).

As Ostrom et al. (1961) stated, a polycentric community constitutes several independent political decision-making centers that thrive on cooperative and competitive relationships. These relationships revolve around contractual and inter-local service

agreements buttressed on tenets of efficiency, effectiveness, and service delivery. The multiple political jurisdictions within a polycentric community strive to operate in a coherent manner with consistency and stable behavioral patterns for the betterment of the citizenry. To the extent these political bodies operate in the aforementioned fashion is to infer they work within a dynamic open system spanning multiple policy boundaries.

With regard to protecting the United States from the policy boundaries of terrorist activity, natural, and human disasters, Wise (2002) asked: "Which approach to organizing homeland security: hierarchy or network?" (p. 141).

Hierarchy (Centralization) or Network (Decentralization)

According to Ostrom (1976), the debate over centralization and decentralization began in the 1780s when the citizenry placed the confederation failures against the promise of federalist principles. The federalist principles delved into a system of overlapping communal interests and the government structure required to solve societal issues. The centralization of power within this framework lies with the decentralization throws of the citizen. The contemporary centralization/decentralization debate, according to Ostrom (1976), continued in the 20th century with President Nixon's signing Reorganization Plan No. 2 ("Congress Accepts," 2016), which directly transferred power and authority away from Congressional oversight within the Bureau of the Budget to the President (i.e., creation of the Office of Management and Budget) and created the Domestic Council to assist the president in deciding "what government should do" (Ostrom, 1976, p. 29). Moreover, Eisinger (2006) asserted that President Nixon's efforts to transfer responsibility down to local government through block grants began the

confusion, which continued during the Reagan and Clinton presidencies, as to "…the proper scope and nature of national and subnational roles" (p. 538).

Eisinger (2006) noted that with a reduction of interest in urban problems during the Reagan and Clinton administrations, coupled with a rise in unfunded mandates to state and local governments, a paradoxical relationship blossomed in the Homeland security arena. Further, after 9/11, the federal government was experiencing a decision dilemma as the homeland security agenda appeared to require a strong central hierarchy that provided support and guidance to state and local governments; however, Washington has since evolved into favoring devolution over centralization.

As Wamsley and Schroeder (1996) noted, the congressional authority fragmentation residing in the Federal Emergency Management Agency (FEMA) has created inherent mission problems relating to the U.S. Constitution and our federalist system. One problem includes federal-state-local relation disconnects and the requirement that FEMA rapidly responds to national emergencies. First, the Constitution provides the states with many broad powers, and the states delegate to local governments much authority in handling local emergencies. This hierarchical relationship leaves FEMA as a last resort emergency responder only after state and local governments have exhausted all resources. Second, FEMA's mission includes coordinating cabinet and other federal agency response efforts to emergencies. The small independent executive FEMA division trying to coordinate activities for strong powerful cabinet departments is synonymous with "the proverbial chicken trying to dance with the elephants" (Wamsley & Schroeder, 1996, p. 242). Lastly, politicians gamble that emergency events, considered low probability events, will not happen under their reign, thus, making it difficult to

coordinate the intergovernmental relations required to handle such emergencies (Wamsley & Schroeder, 2006).

Analyzing the American disaster scene from 1978-1980, Drabek (1985) stated there are four structure qualities inherent in large-scale disasters: (a) localism, (b) lack of standardization, (c) unit diversity, and (d) fragmentation. The localism variable, regardless of structure type, relates to the autonomy enjoyed by first responders in mitigating emergencies. The decentralized structure at the local level, to some extent, promotes a lack of standardization among responding agencies. The lack of standardization within the responding agencies promotes unit diversity between the sheriff, fire, public works, and other rescue units (i.e., fundamental agency differences and role responsibilities). Drabek (1985) therefore concluded that because of these qualities, fragmentation is expected.

Interviewing disaster response officials within the emergency networks of Kansas, Texas, Wyoming, Washington State, and Mississippi, Drabek (1985) reported the key operational problems encountered during multiple emergencies include (a) inadequate communication networks required to transmit large data bundles; (b) horizontal and vertical network disintegration affecting organizational structure, authority, and scene control; and (c) lack of a coordinated response structure in a fragmented hierarchy. From the above, coordinating response agencies, more than any factor, proved the most difficult function.

One solution for emergency officials to grasp, according to Drabek (1985), includes understanding multi-agency decision-making styles. During emergencies, managers confront simultaneous, yet, contradictory directions. The emergency demands

the quantity and quality of resources within the internal structure move in a decentralized manner, yet, the pooling of various external agencies requires a centralized organizational hierarchy. Understanding different agency histories, cultures, norms, and functioning responsibilities aid in developing a coordinated multi-agency network structure (Drabek, 1985).

According to Comfort (2002), achieving coordination among multi-agency emergency networks depends on unimpeded access to timely, valid information and first responders' ability to engage in information search, exchange, absorption, and adaption. A multi-jurisdictional emergency response on a regional scale requires collaborative efforts from public, private, and nonprofit organizations. Each agency, specifically public entities, requires a knowledge base to handle rapid and deteriorating conditions in a quick and capable manner. These dynamic working conditions present the emergency manager with an operating environment consisting of linear (i.e., routine) and non-linear (i.e., extreme) systems. This environment, Comfort (2002) noted, presents two continuum extremes, the difference between organized hierarchy and adaptive system theory.

Comfort (2002) identified five phases of auto-adaptive processes that emergency officials can utilize in linear and non-linear systems: (a) information search, (b) information exchange, (c) sensemaking, (d) adaptation, and (e) inter-organizational learning. Information search is the basis for making prudent decisions in urgent, uncertain environments; it requires working and like communication infrastructures (i.e., radios, dispatch, cell phones) among all response organizations to heighten responders' safety exposure. Information exchange, a direct relation to information search, requires open communication networks between responding agencies working on the same central

communication point (i.e., joint information center). Without proper information exchanges, agency coordination becomes disrupted and jeopardizes rescue efforts. Sensemaking is the first responders' ability to employ past experiences in dealing with current emergency situations. Sensemaking, like adaption, is a form of learning where senior-level officials process information and change behavioral actions as the external environment demands dictate. The last phase, inter-organizational learning, is evaluating the macro system-wide response activities, and modifying any actions based on situational awareness and present results (Comfort, 2002).

Improving multi-agency response capabilities and decision-making processes requires officials understand and incorporate system-wide functions embedded within the auto-adaptive paradigm. Implementing this strategy requires an extensive shared knowledge base coupled with communication and feedback loops open to all agencies. Disaster management requires systemic structuring not from hierarchical ordering "…of responsibilities and resources" (Comfort, 2002, p. 46) within jurisdictional borders; rather, the system requires flexibility to assign personnel and resources based on the external threats presented at a given point in time.

The disaster management partnerships and the need for greater inter-organizational learning, as stated by Caruson et al. (2005), have increased post 9/11. The exposed response deficiencies emanating from the 9/11 attacks in the areas of communication, government preparedness, and lack of coordinated efforts has increased awareness for regional approaches to homeland security issues. Certain intergovernmental scholars advise that regional emergency response systems might

emerge as the "most effective balance between size, capacity, and specificity needed for effective action" (Caruson et al., 2005, p. 144).

Regional structures, according to the research in economic development, might aid cities and counties in achieving scale economies in service delivery mechanisms. Through regional cost-sharing arrangements, local governments benefit from capitalizing on many local economies and potentially improve interpersonal networks from a horizontal and vertical perspective (Caruson et al., 2005).

According to the United States General Accounting Office (GAO, 2004) report, the threat of terror is region-wide, not jurisdiction specific. Therefore, the most effective response matrices are coordinated and designed across several jurisdictional boundaries. This effort comes with challenges as the density of urban areas across multijurisdictional areas makes coordinating homeland security programs difficult (GAO, 2004). However, (Caruson, et al., 2005), note that local first responder agencies understand the importance of not approaching this dynamic environment alone and are advocating more regional solutions to homeland security mandates, specifically in the areas of communications and funding.

With regard to public safety, a strong horizontal network tie "…provides the foundation for an effective regional approach" (Caruson et al., 2005, p. 146). The GAO (2004) report advocated incorporating a collaborative regional approach among many stakeholders across disciplines for enhancing emergency preparedness goals. This horizontal federalism of interlocal relations/agreements is becoming more prevalent in metropolitan areas and, from a public administration perspective, is becoming a critical social network in dealing with complex policy issues. Emergency management officials

are adapting to a new work environment of coordinating several service nodes (i.e., agencies) and administrative structures, coupled with multiple network links (Caruson et al., 2005). The network consists of local government officials managing the critical duties of emergency preparedness, while first responders manage the front-line response operations (Caruson & MacManus, 2006).

In addition to the horizontal networks, regional coordination and the vertical networks of federal-state-local relationships are encouraged through federal grant programs. Through its grant design and requirement stipulations, the federal government promotes regional coordination by prompting state and local governments to form collaborative partnerships prior to releasing federal funds. Some grants require state and local governments to develop a strategic plan with measurable goals and objectives; moreover, the grantee must show that the plan conforms to a certain statute or program in the region. Lastly, some federal grant requirements allow local jurisdictions the flexibility to organize in a manner consistent with a region's target hazards and risk vulnerabilities (GAO, 2004).

One month after 9/11, the state of Florida under the governorship of Jeb Bush signed Executive Order 01-300 (Florida Department of Law Enforcement, 2002). This EO created seven regional domestic task forces under the auspices of the Florida Department of Law Enforcement (FDLE). The horizontal and vertical networks of multi-jurisdictional agencies coordinate response efforts relating to acts of terrorism while ensuring proper training for emergency response personnel and statewide information dissemination on terrorist intelligence. A FDLE director and local sheriff chair each regional division, with the local task force members being police and fire chiefs,

emergency management directors, public health officials, local elected politicians, and private industry chief executives (Caruson & MacManus, 2006).

Analyzing the horizontal and vertical networks within Florida's seven regional task force divisions, Caruson et al. (2005) stated the inter-organizational networks significantly differ across the state due to varying government structures, regional intergovernmental complexities, homeland security vulnerabilities, and regional networks. In the Tampa, Miami, and Orlando regions, local government officials report on "excellent" network relationships with federal and state emergency partners. The only exception is the Miami region, where the results showed that government officials were not as likely to have strong network ties with state officials. Strong horizontal network partnerships, according to the findings, emerged from regions with complex intergovernmental structures (i.e., based on number of counties, special districts, and municipal governments within the region). The west central (Tampa) region reported excellent relationships with neighboring municipal governments as compared to the least complex region north central (Tallahassee) that reported low intergovernmental network ties (Caruson et al., 2005, p. 162). "In general, where intergovernmental complexity is greater, vertical and horizontal networks tend to be more extensive and are judged to be of higher quality" (Caruson et al., 2005, p. 163).

Building on their 2005 study, Caruson and MacManus (2006) surveyed 414 county and city officials in the state of Florida to ascertain if intergovernmental relations at the local level "…have changed as a consequence of state and federal homeland security mandates" (p. 526). Specifically, Caruson and MacManus (2006) asked if homeland security mandates increase cooperative intergovernmental relations; enhance

vertical and horizontal networks among local officials; and affect financial, political, or legal operations at the local level.

With regard to improving intergovernmental cooperation between Florida's local governments, when the Department of Homeland Security mandates policy to state and local governments, Caruson and MacManus (2006) reported that officials cite increases, not decreases, in intergovernmental partnerships. The results also show that practitioners believed intergovernmental relations would improve as homeland security mandates flowed down the vertical network. Thus, forced homeland security initiatives potentially can cause an arena of contingency federalism where mandates serve to nurture and build vertical and network ties in a given state or region (Caruson & MacManus, 2006, p. 527).

With respect to additional management and financial burdens on local governments as federal and state emergency preparedness mandates trickle down, Caruson and MacManus (2006) reported a higher financial burden for municipal governments and a higher administrative burden at the county level. The research shows that preparing for homeland security measures "…is an extremely expensive task, made even more fiscally burdensome for municipalities, which, compared to counties, have fewer revenue sources" (Caruson & MacManus, 2006, p. 528), yet they provide more functional, service-delivery during an emergency.

The results concerning intergovernmental networks among city, county, state, and federal officials, according to Caruson and MacManus (2006), appear driven by partnerships with the state government. The research shows that counties possess stronger network ties with federal and state cohorts; however, city officials reported a similar number of quality relationships with state agencies, and cited higher a relationship with

the federal government than county respondents. The city-to-federal relationships probably stem from numerous federal grant programs where funds go directly to the cities. Lastly, the intergovernmental horizontal networks of county-to-county, city-to-city, and county-to-city appear strong; however, the perception of strength varies among city and county officials. Among city officials, 94% report strong interrelated ties with other cites, while only 76% report networks with county officials. Contrary to expected hypothesized direction, counties reported greater general-purpose horizontal networks compared to city officials (Caruson & MacManus, 2006).

Even with Florida demonstrating successful emergency management interlocal collaborative efforts on a consistent basis, Caruson and MacManus (2011) advised that several hurdles still exist after the 9/11 and Hurricane Katrina disasters; and that "the most focus has been on interlocal service agreements (ISAs), the need for which has largely been driven by budgetary shortfalls" (p. 166). Through much empirical research, scholars have concluded that transaction costs are the major barriers against interlocal cooperation. Even with local governments knowing that ISAs provide benefits gained from cooperation, there is a collective action problem in designing and implementing collaborative agreements to standardize multi-jurisdictional operations (Caruson & MacManus, 2011).

Roadblocks existing throughout Florida, according to Caruson and MacManus (2011), include incompatible communication equipment, the primary deterrent to intergovernmental cooperation. The fiscal roadblocks at the local levels prevent many communities from obtaining the needed interoperable equipment – even after it was noted as a major deficiency during the 9/11 events. Other horizontal constraints include

administrative complications concerning cost-sharing arrangements, along with barriers to information sharing and strong competition for needed emergency preparedness funding. Lastly, though minor as compared to communications, political posturing among jurisdictions was a constraint coupled with training and personnel differences among jurisdictional boundaries (Caruson & MacManus, 2011).

Research Purpose

The purpose of this study was to explore the existence, or lack thereof, of scale economies within a Florida county that serves various fire agency organizational designs. The county used in this research consists of a centralized/consolidated fire and emergency medical services agency, a city fire department, and a decentralized ISFCD.

This study addressed the existence of scale economies among a consolidated county fire department, a city fire department, and an ISFCD, coupled with analyzing the ISAs among the respective agencies. For this study, scale economies exist if the average cost of producing a given level of service decreases while the service level(s) production (i.e., outputs) increases. Diseconomies of scale exist, or are implied, if the cost per unit of a service produced increase as output increases. For purposes of this study, fire production output equates to the primary independent variable of quarterly emergency calls for service.

The research method of inquiry for this study is a concurrent embedded strategy mixed method design. The unit of analysis is the organization type, the ISA used (if any) within a given fire department, and the quarterly emergency calls for service.

The data used in this research came from audited budgetary, economic/financial, and annual emergency service call information from the fire department organizations,

and from organizational ISAs supplied by the respective agency fire chiefs. In essence, what organization type (i.e., county, city, or ISFCD) achieves economies of scale based on quarterly emergency calls for service, and how does the use of ISAs influence economies of scale within the organization types? The four main research questions addressed in this paper are:

1. What is the average cost trend of producing a given level of service for the consolidated county fire department, the city fire department, and the independent fire district?
2. What fire service organizational design, the county, city, or independent fire district achieves economies of scale based on emergency service calls?
3. What type of ISAs (network partnerships) exist within the organizational designs of the county, city, and independent fire district?
4. If ISAs do exist, why were they created?

To answer these questions, there was the need to review the pertinent literature. The overarching goal was to explore and conceptualize the economies of scale literature in the provision of fire services, coupled with uncovering relationships associated with ISAs.

CHAPTER II. LITERATURE REVIEW

According to Wikstrom (1978), the ability to define what the correct government organization structure is in our metropolitan jurisdictions "has become more complex and confusing in recent times" (p. 2). Merger proponents advocate the formation of a metropolitan government that allows the public sector to generate ample revenue streams on a region-wide basis to provide appropriate services in a more effective and rational manner. Moreover, metropolitan advocates opine that public services such as fire, police, and refuse collection are provided "…more efficiently and with economies of scale" (Wikstrom, 1978, p. 3) if delivered on a consolidated basis. This argument leads to the following null hypotheses: A consolidated fire agency is more efficient and achieves economies of scale.

Similar to the economies of scale debates offered from metropolitan style government systems are the issues of transaction and bargaining costs, third-party coercion incentives, fiscal stressors, and consensus/collaboration building (Kraus, 2012). The reason for studying the economies of scale and ISA literature in concert with the appropriate fire service organization structure is because the academic community knows little "…about two or more units of government working together to deliver local public service that is more typical for police, fire, emergency management, and public works" (Chen & Thurmaier, 2009, p. 537).

As Donahue (2004) stated, fire departments are an integral part of our community and nation, and the development of appropriate cost models based on sound scientific

principles has been relatively absent from the scholarly community. Moreover, as Chen and Thurmaier (2009) opined, the collaborative and network literature addressed scholarly research in the public education, economic development, and human services arenas.

To enhance the management and policy prescriptions in the fire, police, and emergency services, scholars need to fill the literature gap among local governments and the delivery of certain public services (Chen & Thurmaier, 2009). Hence, this literature review covers the relevant fire service economies of scale scholarly literature and includes a review of the fiscal stressors conducted with respect to public sector inter-local agreements.

Public Choice

Scholars researching regional government in the United States approach the subject from two fronts: one favoring consolidation and the other from overlapping jurisdictions and networks (Roberts, 2008). Consolidation advocates denounce the fragmented system of overlapping jurisdictions and political authority, while supporting municipal government oversight of numerous regional services. Consolidation advocates note that economies of scale are ascertained in service delivery while achieving equitable resource allocation distribution (Roberts, 2008). In contrast, public choice scholars argue that decentralization of government entities across regions produces scale economies and provides citizens with "choice and competition in services" (Roberts, 2008, p. 425).

As stated by Briffault (1996), public choice theorists recognize that general purpose regionalized governments are not needed to achieve economies of scale in public service delivery models. According to public choice scholars, the economies of scale

issues are solved through interlocal joint planning, financing, purchasing agreements, and delivery of services, coupled with the creation of state-organized, special limited-purpose districts to supply capital-intensive services (Briffault, 1996). The stated forms of interlocal planning devices allows for local control of taxing authorities and service-provision decisions while local residents defend their tax base from external government demands. The key tenet from the public choice perspective, as believed by Briffault (1996), is that local governments not necessarily produce the public services; rather, they establish the quantity and quality of the chosen public services to be provided and paid for by the locality's residents. In turn, the locality may contract with other governments or private firms for the production of a given public service (Briffault, 1996).

Faulk et al. (2005) stated "[f]rom the limited number of studies available on the effects of city-county consolidation, the various research methods used, and conclusions drawn from them, it is possible to draw a few relevant *conclusions*" (p. 2), which include that significant efficiency is not likely, and perceived service quality gains are likely, but in no way assured. With respect to the recent consolidation literature review on police services, Faulk et al. (2005) also reported that economies of scale do not occur when production levels increase; thus, forming larger police departments through consolidation does not lead to lower provision costs. Scheller and Rugeley (2007) noted that scholars studying city consolidation and its effects on local government expenditure patterns are able to get support on both schools of thought. However, this differs from most of the research that suggests consolidations actually increase government spending.

Feiock (2004) noted that the progressive theory of city-county consolidation focuses on service and efficiency enhancements. The progressive scholars have

advocated for cost savings through reducing duplicate services, attainment of scale economies, and enhanced technical applications in service outputs; however, the progressive arguments largely have been discounted through scholarly research over the past 15 years (Feiock, 2004).

On the contrary, the public-choice scholars, specifically, Tiebout's (1956) public economy work, have provided a solid theoretical alternative against consolidation arguing for allocative efficiency in public goods and services (Feiock, 2004). Moreover, New York City fire and police departments responded to the 9/11 attacks within their normal operational modes, but "without an assessment of the interdependent effects of the collapse of the technical infrastructure needed to support their operations, the responders became victims" (Comfort, 2002, p. 39).

According to Farazmand (2002) the public-choice framework is buttressed by the following thematic structure: (a) individual choice and preference as the basis for organization and joint action, (b) rules to guide organizational order and sustainability; (c) the concept of satisficing, not maximizing self-interests; and (d) an incremental approach to group and individual decision-making in the work place and society (p. 35). Schneider's (1986) research postulated that the public-choice environment allows for a variety of public service packages within several competing taxing jurisdictions to provide a competitive market for local public goods. This market allows citizens to act like private market consumers and move to given political jurisdictions that best serve their individual preferences.

Locally financed government service providers such as fire, police protection, education, and hospitals raise important questions for local political leaders to ensure that

proper expenditure mechanisms reflect the rational consumer's wants and preferences (Tiebout, 1956). Given a finite revenue and expenditure base, the consumer-voter moves to a community whose local public services best please his/her set of preferences. The more communities with multiple service provision choices, the greater probability that consumers fully maximize their preference levels (Tiebout, 1956).

Decentralization of individual decision-making, according to Buchanan and Tullock (1962), involves market like alternatives within the political arena. Individuals who possess several political units espousing homogenous policy goals have multiple geographic locations from which to choose various service bundles. The availability of individual choices among several decision packages places parameters on external costs "…imposed by collective action and the expected costs of decision-making" (Buchanan & Tullock, 1962, p. 114). This means that unless there are positive externalities after the process is completed, collective activity should be organized in small, rather than large, political units.

To achieve the proper consumer demand service level within a given spatial boundary, Tiebout (1956) proposed a local government model that includes the following: (a) the non-stagnant citizenry/voters who will relocate to geographic regions that best serve his/her public interests; (b) well-informed voters who know a great deal about government revenue and expenditure patterns; (c) a vast number of communities for the citizenry to inhabit, non-restrictive employment opportunities for the citizenry; (d) public services among communities with no diseconomies or spillover effects; (e) optimum city size that is delivered by the basket of public goods provided at the lowest

average cost; and (f) communities below optimum size market themselves to attract new residents (p. 419).

Adding to Tiebout's (1956) model, Samuelson (1958) incorporated spillover effects (i.e., externalities) into the equation of maximizing public goods. Externalities distort the effective and efficient private-public costing mechanisms, hence, creating an environment of non-Pareto optimality. The rational person enters into market manipulation for the benefit of himself or herself, thus creating a potential burden on society. The crux of optimizing public good expenditure theory, as Samuelson (1958) stated, includes the direct and indirect costs calculated within all social decisions. In essence, public expenditure pricing mechanism may include charging fees for service as dictated by the voter's market demand and supply needs (Samuelson, 1958).

Ostrom et al. (1961) asserted that certain public goods (e.g., police and fire protection) do not enjoy the "exclusion principle" (p. 833); and as such, individuals who do not pay for a certain amount of public good still receive the service benefit. Hence, calculating the production output costs is often difficult and not an exact science. To remedy the latter inequity and ascertain stringent pricing controls over the production and provisions of certain public services, one must develop rigorous quantifiable measurement output standards. In developing production control mechanisms, government producers possess accountability tools to maintain a homeostatic state while keeping optimum performance levels. This level of performance allows citizens' benefits to exceed production and provision costs.

Ostrom and Ostrom (1971) stated that once a public good is provided, the exclusion principle is moot and the individual obtains whatever service is perpetuated, or

he/she may relocate or provide for themselves. The stated conditions deteriorate when preferences diverge, coupled with fluctuating demand levels in conjunction with supply levels of a given service or good. If the collective action of the community is not reflective within the final policy decisions then "…producers of public goods and services will be taking action without information as to the changing preferences of the persons they serve" (Ostrom & Ostrom, 1971, p. 210). In the given scenario, public expenditures can be undertaken with little reference to consumer utility. Of course, provision efficiency in this situation has no meaning.

The consumer/voter and quasi-market theoretical underpinnings under the public-choice purview, according to Schneider (1986), are one stream of scholarly reasoning; another argument delves into relationships between the size of service units and efficient service provision. The overarching theme entails economies of scale or the lack thereof. Public-choice scholars opine that, given the nature of most local public services, inefficiencies result from consolidation and regional service providers (Schneider, 1986).

Fire Service Economies of Scale

Providing a theoretical framework for expenditure implications and scale economies within police and fire services, Hirsch (1959) opined that distinguishing between demand and expenditure functions is paramount, as per capita expenditure levels and service demands "…are highly correlated with the fiscal ability of the community" (p. 237). Assigning an appropriate scale measure (i.e., unit of service production output) is important for analyzing service integration; however, several other scale measures influence expenditure patterns and automatically increase with population growth. For example, jurisdictional area served, service area population, salaries, quality of fire

protection rendered, average per capita assessed valuation of real property, and dwelling-unit density influence economies of scale when horizontal service integration takes place (Hirsch, 1959).

Building upon Hirsch's framework, Schmandt and Stephens (1960) asserted the need for a service output index when determining economies of scale models within the fire and police services. Instead of statistically analyzing only service input functions (i.e., salaries, equipment, and number of personnel), decision makers need to breakdown categorical outputs of a given service provider. The output functions of police activities include foot and motorcycle patrol, criminal investigations, school crossing guards, radar speed units, and public outreach programs. Then, using simple rank and order coefficient modeling, the analyst can devise a variable correlation table to perform multiple linear regression analyses. To check for statistical validity, Pearson multiple and partial correlation coefficients are computed for a given service against selected independent variables (Schmandt & Stephens, 1960).

From the standpoint of fire protection, as Hirsch (1964) noted, the location of fire stations is user dependent; hence, longer travel distances to the end user render the service inefficient. A second efficiency measure concerns the labor intensiveness of providing fire protection services that directly correlate to wage and salary issues on the budgetary process.

Analyzing the relationship between variations in municipal expenditures (i.e., per capita public employment), Gabler (1969) built a theoretical model around three measures of population – jurisdiction size, population density, and population change. To account for variations in labor efficiency and salary pay scales among different

municipalities, employment data serves as an index from public urban sectors to smooth out the explanatory factors. To assist in explaining variations within cities' per capita expenditures and employment ratios, Gabler used six independent variables that included (a) number of people within a city, (b) number of people per square mile, (c) rate of population growth, (d) percentage of population greater than 65 years old, (e) median number of school years completed for those 25 and older, and (f) median household income.

The importance of analyzing population changes and jurisdiction size, as believed by Gabler (1969), may relate directly to expenditure and employment per capita because population size can lead to either economies or diseconomies of scale. On the one hand, population can be so large that the average cost increases, creating diseconomies. On the other side, cost spreading occurs as population increases, thus causing average cost to decline, i.e., economies of scale (Gabler, 1969).

Popp and Sebold (1972) offered an alternative police service model of scale economies and public service cost functions not stated in the Hirsch (1959) and Schmandt and Stephens (1960) studies. Specifically, externalities present across jurisdictional boundaries from the production and consumption of public services, even in the absence of internal economies of scale – "…make consolidation an attractive means of improving allocative efficiency" (Popp & Sebold, 1972, p. 47). Adding this measure to the equation forces policymakers to consider urban growth and consolidation as distinct, yet, related policy questions.

Popp and Sebold (1972) stated that police service is to protect lives and save property in a given spatial area. To optimally protect lives and save property, police

services attempt to achieve higher production outputs through an increase in crime prevention and property recovery procedures. However, the latter equation does not take into account the quality of service levels that vary across service jurisdictions. To standardize the service level an assumption is made to account for unrecovered losses such as foregone earnings and medical costs due to personal injury to the crime victims across jurisdictional boundaries. Each crime victim receives compensation with losses being absorbed by the respective governmental entity. Hence, each citizen within this model receives the same amount of police service. Police output, therefore, is calculated on a standardized basis across the respective jurisdictional area. Popp and Sebold (1972) have used the following variables to calculate economies of scale: (a) total expenditures of crime prevention, (b) total unrecovered losses, (c) number of crimes committed, (d) average gross loss due to a crime category, (e) average value of recovered losses due to particular crime categories, and (f) service area population (p. 49).

To determine economies of scale within the provision of fire services, Ahlbrandt (1973) used and expanded Popp and Sebold's (1972) linear regression analysis, noting that the average cost curve for public sector services can be estimated directly from the production outputs that determine its level. Moreover, the average cost functions of productive output, environmental concerns, technological advancements, service quality, and budget factors influence the manager's production decisions. The regression equation for testing the dependent variable, cost per capita in dollars, is analyzed against the following independent variables: (a) population, (b) assessed property valuation, (c) percentage of housing units lacking some or all plumbing facilities, (d) adjusted wage index, (e) fire insurance rating index, (f) number of ambulance type vehicles, number of

volunteers, (g) number of full-time personnel, (h) number of fire stations, and (i) square miles (p. 5). These variables, according to Ahlbrandt (1973), can be used to test for economies of scale as the community size increases.

Using similar independent variables, Gustely (1977) analyzed the situation for the Dade County (Florida) consolidation against a sample group of surrounding non-consolidated municipalities and postulated that, devoid of consolidation, public expenditures are dependent upon the following variables: (a) the median value of owner-occupied homes, (b) percentage of the county population concentrated in certain geographical areas, (c) percentage of Black population, and (d) percentage of funds raised through the property tax (p. 355). Using regression analysis, Spearman rank correlation, and Kendalls Tau, Gustely (1977) attempted to develop a causal relationship between the stated variables for 25 Florida cities with populations greater than 5,000 and a consolidated group of Dade County public services (i.e., fire, police, hospitals, and highways).

The net financial result of the Dade County experience concluded that poorer jurisdictions favored greatly over the more affluent municipalities (e.g., Coral Gables). In absolute dollar figures and percentage variances, the City of Miami was the largest service beneficiary of the Metro experience, while Coral Gables and North Miami Beach experienced the greatest financial burden (Gustely, 1977). With respect to the economies of scale debate, expenditures increased after consolidation. One reason for the expenditure increase was the leveling out pay scale differentials throughout the county post-consolidation. Another factor that added to the increase included a labor agreement among the new county government and the consolidated municipalities. In order for

Metro-Dade to gain authority over certain municipalities, they conceded to retain jobs from the lower government ranks (Gustely, 1977).

Brueckner (1981) asserted that incorporating econometric congestion property modeling for local public goods is paramount "…where city population is chosen to maximize the welfare of urban residents" (p. 57). The general public service congestion model includes a given consumption level, a public good fixed level, a measure of physical output, a consumer demand group, and appropriate environmental variables affecting a stated consumption level based on the service supply. In the case of fire protection, congestion properties of various communities depend on the Insurance Services Office (ISO) rating of the jurisdictions. The ISO rating is a function of a community's fire department operations, water supply capabilities, fire communications system, and level of fire hazards (i.e., building age and construction type). Hence, a community's fire suppression capacity is directly dependent upon their water supply infrastructure and service delivery capabilities as well as the fire department's ability to pump water on emergency scenes (Brueckner, 1981).

Utilizing 1972 census data, 1978 ISO ratings, and sampling from 100 communities throughout the United States with residents exceeding 30,000, Brueckner (1981) noted that fire protection levels increased directly with fire and water expenditures and indirectly with fire hazards and population. From Brueckner's research, a 1% increase in community population leads to approximately 0.25% decrease in the level of fire protection, holding fire protection and fire hazards constant. However, with no change in per capita fire department expenditures, fire protection output increases with the population. This, therefore, shows that population increase results in positive scale

economies when restricted to communities with above par ISO ratings and lower per capita cost in a larger community.

Expanding the fire service economies of scale literature base, Mehay (1984) postulated that fiscal outlays for fire service districts differ depending on their organization design (e.g., as single-purpose governments or as smaller units of larger city/county governments). In essence, Mehay (1984) opined that local fiscal outlay is higher, all things remaining equal, when two services are provided by a multi-purpose government model than when the same two services are provided separately by two single purpose governments.

Using 300 fire districts ($1/5^{th}$ dependent) and 82 park districts ($1/3^{rd}$ dependent) in California, Mehay (1984) noted that variations in district expenditures is equal to the summation of the following variables: (a) intergovernmental aid to districts, (b) county population of the various districts, (c) population density of said county, (d) average monthly wages of workers in said county, and (e) population growth rate of said county (p. 344). Using ordinary least squares, Mehay's regression equation shows a significant relationship at the .01 level for all variables encompassing fire protection, regardless of employing district level variables and county population, or adding county level variables into the mix-coupled with a 40% appropriations increase for dependent districts.

Based on Mehay's (1984) research, it is clear that the bureaucracy and median voter theory cannot be linked to the regression estimates; however, it appears that multipurpose governments still live more by the politician-bureaucrat than the median voter. This reinforces the assertions that fewer constrictions placed on multipurpose governments lead to increased fiscal and budgetary outlays.

Buchanan (1999) asserted that fire station location, in terms of fixed amounts, is not divided equally among community households; thus, the quantity of fire protection is not equal for individuals living further away from the origin point. However, fire protection services are equally available to all joint consumers regardless of distance from station location; therefore, joint consumers receive an equal quantity of protection, so long as fire protection is defined "…strictly *in production or supply units*" (Buchanan, 1999, p. 53).

Buchanan (1999) further postulated that the fixed location of fire stations determines the community's service levels received. Buchanan noted further that the mix of public goods available to all consumers within a given region include the locational-technological characteristics of the supplied units and, with regard to the dependent variable fire station, the quantity and quality of fire protection received in a given area influences the independent variable of location.

The economies of scale debate, by providing public functions as Duncombe and Yinger (1993) asserted, produces serious obstacles. First, Duncombe and Yinger (1993) noted public outputs are difficult to measure, and corresponding production functions are difficult to observe. Second, analyzing public expenditures are observable easily; however, incorporating expenditures into regression modeling requires stringent assumptions on the technology variables and service quality index. Third, the connotation of scale in public production encompasses three dimensions: service quality, activity levels or production outputs, and number of people served in a given spatial boundary.

Using econometric modeling and 2-stage least squares regression, Duncombe and Yinger (1993) analyzed paid, municipal New York State fire departments to show how

estimate returns to scale on service quality, population, and production output are achieved in fire service organizations. The model assumes that voters select desired service levels and elected public officials minimize costs subject to budget and production constraints.

The main issues considered by Duncombe and Yinger (1993) included analyzing the influence of building conditions on service quality elasticity with respect to production output, cost function fluctuations in relation to final production output, and how population density per a given jurisdictional area and building height affect production functions (i.e., tradeoff between fire stations and personnel). The findings reported by Duncombe and Yinger (1993) included poorer building conditions, coupled with increased building height, negatively influence fire suppression and prevention service level tradeoffs, resulting in a decreasing returns to quality scale (i.e., higher production costs). The returns to quality scale function (i.e., costs to operate a given fire organization) vary proportionately with designated fire suppression and prevention activities; however, increasing fire protection activities may lead to increasing economies of scale and scope activities, thus, reducing average cost curves (Duncombe & Yinger, 1993).

In addition to fire suppression and fire prevention activities, Donahue (2004) stated the actions of managers influence government performance cost curves. Along this line, Donahue (2004) analyzed transformed managerial inputs into outputs through the econometric modeling of government organizations and administrations. According to Donahue, management decision-making influences cost-efficiency models to the extent that decisions (i.e., assumptions) depend on an understanding of a community's fire

protection level and knowledge capabilities concerning resources and capabilities. Strategic management functions further the cost-efficiency argument through development of goal consensus, operational plan development, and evaluation standards to ensure performance improvement (Donahue, 2004).

Using a single-stage 20 county cluster sample of New York State fire departments with surveys given to 173 fire chiefs and using 2-stage least square regression analysis, Donahue (2004) analyzed the independent influence of managerial actions (i.e., recordkeeping, training, management style, and performance measurement) on the cost of fire protection. To ascertain the managerial influences on fire protection costs, Donahue analyzed the following department characteristics: (a) enhanced performance monitoring and measurement capabilities lead to greater cost efficiencies, (b) greater centralization and hierarchy structure mean less efficiency, and (c) employing modern firefighting technology equates to greater efficiencies (pp. 75-77). The findings, as reported by Donahue, showed that greater performance assessment capacity leads to greater cost efficiencies, as managers possess the proper tools for resource deployment and production technology maximization. The results also show that more participatory/collaborative management regimes promote cost savings and lower per capita costs and modernized firefighting units with advanced technology produce higher costs per capita. This directly corroborates with the diversity of emergency responder missions and the technology needed to confront today's public safety challenges.

According to the GAO (2004) report on emergency preparedness, the Department of Homeland Security's Urban Area Security Initiative (UASI), during fiscal year 2003, allocated more than $500 million in grant programs to urban areas considered at high-risk

for terror attack. Some of the areas receiving federal funds covered multiple jurisdictions such as city/county, and two areas, New York and the Washington, D.C. National Capital Region (NCR), covered more than one state. The grants covered expenditures for enhanced coordinated training, joint exercise planning, fostering collaborative dynamics within a regional framework, and general administrative efforts. This report noted that the threat of terror is region-wide, and the resource utilization to mitigate such emergencies is not jurisdiction specific; rather, it is a coordinated effort between many different agencies across jurisdictional boundaries (GAO, 2004). The report also noted, effectively managing and mitigating these incidents requires well-trained and supervised professionals working together in a coordinated manner.

Outside the realm of fire service econometric modeling studies, today's scholars are forging new theoretical developments in the areas of intergovernmental relations, regionalism, and metropolitan governance. These theoretical developments fuse fragmented jurisdictions into complex social networks that solve complicated public policy problems through webs of multi-jurisdictional coordination efforts, interlocal service cooperation, and interlocal agreements (LeRoux, Brandenburger, & Pandey, 2010). Like consolidation studies that attempt to explain scale economies, efficiencies, and externality effects, the trans-jurisdictional nature of today's social networks delve into similar conceptual modeling with greater emphasis on community homogeneity/heterogeneity, goal congruence, fiscal stress, and trust constructs (Hawkins, 2009).

Fiscal Stress, Goal Congruence, and Trust

Feiock (2007) posited that an agency's ability to share resources through a coordinated network depends on bilateral reciprocal efforts and is a function of multilateral collective action, which is represented by the coming together of two or more government units for purposes of minimizing production costs while minimizing spillover externalities. The crux of ICA focuses on how the elected officials perceive and weigh the costs of providing a benefit (i.e., public service) to the community through cooperative agreements and other intergovernmental service arrangements. How elected officials and administrative leaders perceive these costs depends on the decision setting environment, the type of public good under discussion (e.g., fire, police, public works), and the current network relationship among governing agencies (Feiock, 2007).

Through researching the extant interlocal agreement (ILA) literature, Chen and Thurmaier (2009) formed several research questions around the reasons for forming ILAs. For example, fiscal conditions of a local government are important in forming an ILA as is the need to improve service delivery effectiveness. Using a sampling frame of 601 cities and 99 counties within the state of Iowa, they attempted to gain a perspective from the city or county government on the success of ILAs with goal achievement, efficiency, and effectiveness as the independent variables. Controlling for population and service type and using ordered logit regression, Chen and Thurmaier (2009) tested the norms of equity and reciprocity with respect to distribution of costs and benefits against the degree to which the ILA was considered successful. The results of their research inferred that the main impetus for joining an ILA is not due to fiscal stress; rather, it is the need for gaining efficiencies and effective service delivery. The findings also inferred

that the impetus for joining an ILA is dependent upon the beliefs that service delivery can become more effective and efficient.

The findings in the Chen and Thurmaier (2009) study coincide with the assertions articulated in Andrew's (2009) bonding hypothesis that predicts local governments will form ties with partners of their existing partners to group resources and reduce commitment risks. In the police and fire service transactions, according to Andrew (2009), the stochastic nature of mutual emergency event planning presents problems for local officials; thus, measuring service outcomes becomes a difficult task. Based on the mutual measurement difficulty, the presumption is, "…a highly dense network structure will emerge over time as local governments attempt to mitigate the problems of shirking" (Andrew, 2009, p. 383).

Testing the bonding hypothesis within the Orlando-Kissimmee metropolitan area, Andrew (2009) analyzed contractual arrangements among fire and police agencies (specifically 66 contractual arrangements with emphases on police services) according to Feiock's (2007) ICA framework. The study attempted to draw inferences "…about the type of control mechanisms that can enhance a particular configuration of ties, and thus, regional integration" (Andrew, 2009, pp. 396-397).

Using simulation investigation network analysis (SIENA) software, Andrew (2009) found that policy planners may infer that entering into a contractual agreement with another like agency possessing high measurability problems does not guarantee benefit maximization as this is dependent upon other variables such as contract establishment and maintenance costs. The overall findings suggest that regional integration is an incremental process evolving over time, with decisions to enter into

various ILAs dependent upon prior successful interactions. Andrew (2009) noted that the direct implication to emergency service planners is that agencies possessing open/informal communication channels and a shared resource network, maximize a region's ability to handle emergencies through resource sharing.

Using the ICA framework on a sample of 163 cities within the state of Georgia serving populations greater than 2,500, Shrestha and Feiock (2011) proposed the following hypotheses: (a) a rise in asset specificity means an increase in the *likelihood* and the *level* of interlocal cooperation but beyond some point, asset specificity decrease the *likelihood* and the *level* of interlocal cooperation; (b) greater measurement difficulties in evaluating program outcomes increases the *likelihood* and the *level* of interlocal cooperation, but beyond some point, measurement difficulties reduce the *likelihood* and the *level* of interlocal cooperation; and (c) the greater reciprocal exchange relationships are shared among parties, the *likelihood* and the *level* of interlocal service cooperation increases (pp. 575-576).

Employing a Heckman 2-stage regression, Shrestha and Feiock (2011) used the dependent variable ICA and the independent variables of (a) asset specificity, (b) measurement difficulty, (c) reciprocity in exchange relationships, (d) cities' fiscal condition, (e) city size, (f) racial heterogeneity, (g) government type, (h) median household income, and (i) group size of local government to assess the relationships among the variables (p. 578). The results of the estimation show the variables' group size, city size, coupled with transaction behaviors of service and reciprocity, revealed a statistically significant relationship on interlocal cooperation. The larger size government was less likely to enter into local cooperative exchanges; conversely, smaller

governments are more likely to enter into cooperative relationships. Their first and second hypotheses were supported where the probability for entering into interlocal cooperative arrangements initially increased, as service transaction costs associated with asset specificity and measurement difficulty are low. However, when transaction costs for asset specificity and measurement difficulty rise beyond a given point, the likelihood for interlocal cooperative arrangements decline (Shrestha & Feiock, 2011, pp. 579-582). Lastly, the results supported their third hypothesis – "the likelihood of adopting interlocal cooperation increases for cities with reciprocal exchange" (Shrestha & Feiock, 2011, p. 579).

According to Shrestha and Feiock (2011), local government officials need to realize that when dealing with interlocal cooperative agreements, the mutual discourse among all parties is paramount for emerging partnerships. Positive transaction exchanges rely on embedded relational networks based on mutual trust and mutual agreements, coupled with parties sharing in goal congruence.

Buttressing Shrestha and Feiock (2011) conclusions, Lundin's (2007) study focused on the effects of resource interdependence and goal congruence on trust. Using the Swedish active labor market, Lundin (2007) examined trust on the 2-tiered government levels of the Public Employment Service offices and municipal labor market agencies. Lundin hypothesized that: (a) trust levels are dependent upon the effects of resource interdependence on organizational cooperation, and (b) trust levels are dependent upon similar (or diverging) objectives on interorganizational cooperation.

The main findings from Lundin's (2007) research is that congruent goals are not a clear indicator of promoting cooperation when trust is lacking. Moreover, mutual trust

will not increase cooperation when public authorities have different goals and priorities. In essence, mutual trust and goal congruency must occur concurrently (p. 669).

The implications for public managers wanting to increase collaboration, as Lundin (2007) asserted, is to highlight agency commonalities, coupled with introducing open communication and reporting systems. Sharing information in an open setting aids officials in designing congruent goals and establishes trust early in the collaborative processes. Designing meaningful collaborative agreements includes agencies sharing similar goals with high trust levels.

The literature review presented formed the basis for this research study and provided the starting point for exploring the development of a new fire service scale economy causal model regarding fire department organizational design. The next section details the research methodology used in developing the model.

CHAPTER III. METHODOLOGY

As the literature review revealed, there is a paucity of scholarly literature relating to fire service economies of scale in conjunction with ISAs. This research attempted to bridge the scholarly gap by incorporating a mixed methods design of quantitative and qualitative data. The simultaneous quantitative and qualitative data collection phases offered from the concurrent embedded strategy allowed the researcher to gain a broader perspective from the entire data set and allowed different components within the organization to be studied concurrently. The quantitative data collected on the economies of scale variable was used to describe the aspects of the qualitative data that cannot be quantified (Creswell, 2009).

Table 1 shows the independent predictor variables used against the respective three fire departments' quarterly expenditures (dependent variable) to operate the fire department. The computational outcomes determine whether economies of scale are ascertained. In other words, do the average costs of producing a given level of fire service(s) decrease as certain measures (i.e., emergency calls for service or population) increase?

The qualitative ISA component encompasses an exploratory field study using informal face-to-face interviews with fire chiefs in a specific Florida county. The remainder of this chapter discusses the following components: (a) sample description, (b) governing state of Florida statutes, (c) sample design, (d) instrumentation, (e) procedures, and (f) data analysis justification.

Table 1

Predictor Variables

Independent Variables	Definition
Annual Emergency Service Calls – quarterly figures used in analysis over an 11-year period for 44 data points	Number of emergency calls reported to the State of Florida for annual reporting and auditing into the Federal NFIRS system.
Service Area Population	Full-time and seasonal residents residing in the jurisdiction's boundaries.
Operations Personnel	Number of full-time fire suppression personnel – 24 hours/day, 365 days/year.
Apparatus	Number of front-line apparatus used for emergency response calls.
Fire Stations	Number of fire stations in a given jurisdiction.
Square Miles	Number of square miles in a given jurisdiction.
Cost per Capita	Change in average quarterly expenditure cost based on quarterly population estimate – this accounts for seasonal and non-seasonal population variations within the respective fire department's jurisdiction – TFC +TVC / Q.
Cost per Square Mile	Change in average quarterly expenditure cost based on the respective fire departments' jurisdiction quarterly square mile - TFC + TVC / Q.

Sample Description

To further the fire service economy of scale literature it was paramount to analyze a county with various fire department organizational designs and service delivery methods. As the literature review revealed, there were no studies analyzing different career fire service organizational designs, scale economies, and ISAs from within a single region (i.e., county). Hence, for this study, the selection includes a Florida county with a career consolidated county-wide fire and EMS department, a career city government fire

department, and a career Independent Special Fire Control District separate from the county and city fire agencies.

The sample description for this research, included organizations, documents, and participants. The organizations were the three career fire departments; the documents included the organization's budgets, emergency calls for service and department characteristics, and jurisdictional demographic information; and, the participants included the three respective fire chiefs from each organization and accompanying deputy or assistant chief officers as deemed necessary for the interviews.

The selection of this particular sample focused on the strengths of the mixed methods sampling characteristics. The data forms generated from the sample included numeric and narrative explanations based on formal and informal frames.

The reason for anonymity during the research and presentation processes stemmed from a phone conversation with one of the fire chiefs, advising that they require legal review and permission from their respective legal department to participate in the research and use their organizational identifier. It was hoped that not using the respective organizational identifier, the entire scholarly community benefits from this research by focusing on a single county geographical area with multiple fire department organizational designs.

Governing State of Florida Statutes

Though not directly a component of this research design or an exhaustive fire service statutory listing (e.g., Emergency Medical Service Transport), the following state of Florida statutes provide the legislative authority and reference to certain constitutional authority to operate within the specific organizational design. For the county

organization, the applicable Florida State statute includes Title XI, County Organization and Intergovernmental Relations, chapters 124-164 (The Florida Senate, 2016). The applicable Florida State statute for the municipal/city organization includes Title XII, Municipalities, chapters 165-185 (The Florida Senate, 2016). The applicable Florida State statute for the independent fire district organization includes Title XIII, Planning and Development, chapters 186-191 (The Florida Senate, 2016). For the independent fire district, chapter 191, Independent Special Fire Control Districts (The Florida Senate, 2016), specifically addresses the unique organizational features of this political subdivision. Lastly, interested persons can look at legislative authority governing the State of Florida fire service, regardless of organizational design, research Title XXXVII, Insurance, chapter 633 Fire Prevention and Control (The Florida Senate, 2016).

Sample Design

The prehospital care environment, consisting of emergency medical services, ranges from minor to immediately life-threatening injuries and illnesses. These work environment parameters take place in dynamic non-static communities under time and resource constraints (McManamny, Sheen, Boyd, & Jennings, 2015). Concurrently, the parameters including prehospital research encompass a vast array of topics to include, but not limited, to clinical, organizational systems, and educational viewpoints (McManamny et al., 2015).

To study the prehospital dynamics, McManamny et al. (2015) stated that mixed methods studies are emerging because they offer an extensive examination into a relatively evolving and embryonic field. Using the mixed methods design allowed the researcher to examine relationships based on applied statistical modeling coupled with

the "…exploration and generation of meaning of contextual factors" (McManamny et al., 2015, p. 215). Moreover, the fire service, as Seley (1979) asserted is a "…anomaly among modern urban public services" (p. 36), and solely using quantitative technical approaches to answer effectiveness and efficiency questions is insufficient for community planning purposes. Seley (1979) opined that not considering qualitative methods in deriving fire service policy solutions leads to a false sense of accuracy in evaluating a community's protection level. Hence, this study statistically examined the relationship between economies of scale and emergency calls for service linked to the narratives of fire chiefs on what variables influence ISAs, and whether those variables impact economies of scale.

This research project, similar to Teddlie and Yu (2007), employed a concurrent mixed method of probability and purposive sampling techniques. The probability techniques generated data for the quantitative strand, and the purposive techniques generated data for the qualitative strand. This concurrent methodology allowed for a corroboration of the quantitative and qualitative strands while sampling the procedure in an independent manner.

The quantitative strand used included the probability sampling frame of an area sample; area sampling includes a cluster of sample gatherings from a specific geographic region (Knapp, 2014). For this paper, the geographic region was a Florida county encompassing certain fire department organizational design types. The total number of Florida counties meeting this sampling design was not quantified purposefully to preserve the anonymity of the sample organizations.

The qualitative strand used was a purposive sampling design where the potential subjects had to possess a complex set of particular job skill set. In this case, the criteria used was the person within the organization possessing the decision-making authority to move forward with initiating, implementing, evaluating, or rescinding current ISAs within the organization. The person with this authority holds the rank classification of fire chief.

Instrumentation

The nature of today's complex homeland security environment and emergency preparedness requirements to protect the homeland exerts increased budgetary pressures on local government entities to form regional partnerships. These regional partnerships (i.e., county fire departments) are created to afford local government entities a method for developing cost-sharing strategies in an effort to achieve economies of scale (Caruson & MacManus, 2007). As Hawkins (2009) noted, cost savings and achieving scale economies are the main reasons cities cooperate and enter into interlocal agreements for service provisions.

Rising to meet the complex homeland security challenges, Kettl (2003) asserted that the general public often is unwilling to accept the reality of reduced emergency service reductions in a war on waste. Waste is part of the political and administrative structures where agencies, budgets, and policy programs do not solely exist to save money or achieve economies of scale in the production of public services. For the homeland to remain secure, our federalist system of emergency services not only requires strong political leadership, but, a system of tightly knit administrative structures producing "…high levels of reliable services" (Kettl, 2003, p. 271).

With regards to the metropolitan governance systems, Chen and Thurmaier (2009) claimed that there is a plethora of research surrounding the economic efficiency debate of local government consolidation versus fragmented local governments. What is less known is two or more units of government working together to deliver public services such as police, fire, and emergency management (Chen & Thurmaier, 2009). Hence, the following sections discuss the appropriate quantitative and qualitative measures used to answer the stated research questions.

Quantitative Instrumentation

Ahlbrandt (1973) used average cost curves for fire service outputs that were estimated directly from factors determining its production levels with least squares multiple regression techniques. Production decisions are determined from output levels, environmental concerns, and technological matters, and variables such as area in square miles, population per area served, operating budgeted costs, number of fire stations, number of personnel, and number of aid cars assist the testing for scale economies (Ahlbrandt, 1973).

With respect to emergency medical service demand and cost estimates, Daberkow and King (1977) advised that one of the primary objectives of EMS planners is to determine who needs the services within a given spatial area – this includes residents and non-residents. Economists, according to Daberkow and King (1977), consider the demand for goods and services as being a function of price and income. However, in the emergency service arena, where life-threatening emergencies exist, the ability to pay principle and the price influence on service demand diminish. Hence, emergency services (i.e., ambulance siting facilities) constitute price and income inelasticity qualities. To

appropriately account for demand estimate functions in the emergency services, Daberkow and King advised researchers to consider calls per resident.

To answer the stated research questions, this research utilized Ahlbrandt's (1973) regression instrumentation procedures, coupled with Daberkow and King's (1977) estimation that focus on calls per resident, to estimate the demand for production output. In this research, calls per resident equates to quarterly emergency service calls for a respective agency, and was the main independent variable.

Qualitative Instrumentation

In reviewing the literature, Chen and Thurmaier (2009) stated fiscal pressures, economies of scale, and service standardization drive the need for interlocal agreements among government entities. Using a statewide Likert-scaled mail survey, Chen and Thurmaier (2009) analyzed interlocal agreements where one single agreement in a given survey frame includes a county and city participating in a particular service delivery. For example, the fire service variable mutual aid represents a single survey frame where county and city fire agencies participate in the interlocal agreement. The success measure(s) for the interlocal agreements focus on goal achievement, efficiency, and effectiveness (Chen & Thurmaier, 2009).

The important component from Chen and Thurmaier's (2009) study used in this exploratory study involved the fire service variable mutual aid, coupled with an additional variable, automatic aid. The survey questions, though not based on a Likert scale as in Chen and Thurmaier's study, asked the respondents about the mutual and automatic response metrics used in their respective fire department. The overarching goal

was to connect the emerging mutual and automatic aid themes to the scale economies debate, and how the aforementioned influence mutual exchanges between the agencies.

In addition to the success measures as stated by Chen and Thurmaier (2009), the researcher determined the type of professional or regional associations, if any, in which the fire chiefs partook. As LeRoux et al. (2010) asserted, there is nothing new regarding the use of interlocal agreements; however, current researchers are forging new theoretical developments in arenas such as intergovernmental relations, metropolitan governance, and regionalism. The emerging theoretical inquiry analyzes interlocal agreements in a systems context among network actors in fragmented jurisdictions.

The component from LeRoux et al's. (2010) research model important to this study was the inclusion of regional and professional association questions asked of the respondents, and how this form of social networking potentially influences daily operations. As LeRoux et al. (2010) used a binary/dichotomous response instrument for participation in a professional association, this researcher employed the same with the intent to elicit how networks within the same discipline (i.e., fire service) might enhance trust. Moreover, if the fire chiefs were involved in certain networks, were the value-systems designed with a long-term outlook towards creating efficiencies and effectiveness in their respective service delivery model (LeRoux et al., 2010)?

The survey instrumentation design used to understand the fire service delivery model in this research emanated from Thurmaier and Wood's (2002) exploratory study of ISAs as social networks. The overarching goal underlying these partnerships, as described by Thurmaier and Wood (2002), is to provide effective services at the least possible cost to its citizenry using an appropriate resource allocation based on the

economic and political environment. Like Thurmaier and Wood (2002), this research used cities and counties with varying demographics and historic dynamics, and interviewed chief administrative officers from each jurisdiction, using open-ended questions to probe and elicit a conversational tone concerning interlocal agreements and service networks.

Though the questions in the current survey instrument were specific to ISAs in the fire service, the intent was to elicit conversation from within certain sections relating to the stated four components within Thurmaier and Wood's (2002) survey instrument (Appendix A).

Procedures

Quantitative Procedures

On January 4, 2011, the State of Florida Office of the Governor issued Executive Order Number 11-03, re-establishing the Office of Open Government previously established under E.O. 07-01 (Florida Governor, n.d.). This office facilitates Floridians' right to know which government agency remains accountable to its citizenry. The information ascertained emanates from state of Florida websites and public records requests (Florida Governor, n.d.).

The procedures used to gather 11 years of financial and budgetary data from the three fire departments included using the official agency's websites in conjunction with the respective agency's public records requests procedures. The website pages where the information was ascertained included the finance and budget divisions, coupled with the individual fire department websites.

Qualitative Procedures

Prior to conducting interviews on human subjects, permission is required from Florida Atlantic University's Social, Behavioral, and Educational Institutional Review Board (IRB) regarding the research project's federal regulation exemption status. Upon receiving IRB determination of federal regulation exempt status (Appendix B), the researcher recruited the study population with an initial phone call, then followed up with e-mails to confirm interview location, date, and time. For the convenience of the participants, interviews were conducted in a conference room at their respective office buildings, following their informed consent.

Prior to conducting the interviews, the approved IRB adult consent form (Appendix C) and verbal script (Appendix D) were read to the interviewee, who either agreed or did not agree to be audiotaped/videotaped. A copy of the signed adult consent form was given to the interviewee.

Data Analysis Justification

Quantitative Techniques

In selecting the appropriate statistical test, this research followed Newton and Rudestam (1999) who noted the importance of conceptualizing the relationships between variables in an analysis. In this particular study, conceptualization of the research variables is shown in Figure 1, where the continuous variables on the left side of the arrow contribute to the continuous variable on the right side. Stated another way, higher appropriated costs for the county, city, and ISFCD are caused by (i.e., dependent on) an increase in annual emergency service calls, square miles, and service area population.

The variables fire personnel, fire stations, cost per capita, and cost per square mile also were considered independent variables and part of the model's equation.

Higher Annual Emergency Service Calls ⟶ Higher Appropriated Costs
More Square Miles Covered ⟶ Higher Appropriated Costs
Larger Service Area Populations ⟶ Higher Appropriated Costs

Figure 1. Variable Conceptualization.

From the variable conceptualization the researcher developed the conceptualized multivariate regression model equation that predicts quarterly fire department expenditures from the stated independent variables. The regression equation is written as follows:

Equation 1. Multivariate Regression Equation for Average Quarterly Fire Department Expenditures

$$\textit{Average Quarterly Fire Department Expenditures} = B_o + B_1\,(\textit{Quarterly Emergency Service Calls}) + B_2\,(\textit{Service Area Population}) + B_3\,(\textit{Service Area Square Miles}) + B_4\,(\textit{Number of Fire Stations}) + B_5\,(\textit{Number of Fire Apparatus}) + B_6\,(\textit{Operations Personnel}) + B_7\,(\textit{Cost per Capita}) + B_8\,(\textit{Cost per Square Mile})$$

Another component to selecting the appropriate statistical test, as Newton and Rudestam (1999) asserted, is knowing the level of measurement for the independent and dependent variables. In this study, variables were measured on a continuous scale. Continuous variables share interval and ratio-type properties where values "…can stand up to arithmetic processing" (Knapp, 2014, p. 11).

The last component to properly selecting the appropriate statistical test delves into addressing the major research question(s) of a study. This involves examination to

determine degrees of association or strength among the independent and dependent variables. The statistical technique used in analyzing this type of relationship included multiple correlation and regression analysis. The following research questions are analyzed using multiple correlation and regression analysis:

1. What is the average cost trend of producing a given level of service for the consolidated county fire department, the city fire department, and the independent fire district?
2. What fire service organizational design, the county, city, or independent special fire control district, achieves economies of scale based on emergency service calls?

Qualitative Techniques

Miles, Huberman, and Saldaña (2014) noted it is paramount to write a research report from a particular stance, and the stance used in this research was a combination of scientific rigor with an activist tone. The scientific rigor, as Miles et al. (2014) posited, includes writing with the following attributes: (a) to advance the existing information on a topic, (b) to convince the audience the report is valid and holds truth, and (c) to advance the methodological craft of the research genre. An activist tone, according to Miles et al. (2014), adds a connection between research findings and local policy problem(s), coupled with improved decision-making while providing solutions for action.

The technique used to describe the data analysis gathered from the qualitative interviews followed Creswell's (2009) multi-level step procedure of general to specific. To begin extracting from the general to specific, a causation coding method as described by (Miles, et al., 2014) was used to validate the accuracy of the raw information collected

from face-to-face interviews. This first-cycle coding process is particularly appropriate for discerning variable interrelationships from within a policy program, or as preparatory work before visually diagramming a causal process due to networks. In the case of ISAs and fire service networks, causation coding allowed the researcher to visualize the pathways of what variables were related to the use of ISAs.

After completing the initial first-cycle coding process, like Miles et al. (2014), this research used pattern coding as a second-cycle coding process to discern themes, explanations, and relationships among variables and/or people. In conjunction with pattern coding, this research generated a causal network variable list, as displayed in Table 2 that allowed the researcher to brainstorm events, factors, and processes that led to variable creation.

Table 2

Example of List of Antecedents, Mediating, and Outcome Variables on Fire Service ISAs

Antecedent or Start Variable	Mediating Variable	Outcomes
Poor Response Times	Dispatch Reports	Additional Engine Company
Funding Levels	Group Discussions	Boat Team

The last component of the qualitative techniques used included a narrative encompassing the causal variables obtained from the coding processes with a story-like account of why the variables were related, based on sound theory. The end product was a network display linked to a network narrative that provided a rich textual depth to the quantitative findings.

The overarching intent of the qualitative techniques used in this research was to provide the scholarly community with a sound, cogent argument that is transferrable to a

similar sample demographic while ensuring reliability for future research. The appropriateness of the subjects interviewed were chosen purposefully; the subjects provide over 90 cumulative years of combined fire/EMS, emergency management, and disaster-related service experience.

To provide the scholarly community with an inquiry into fire service ISAs and their influence on scale economies, the following research questions were analyzed using the aforementioned techniques:

3. What type of ISAs (network partnerships) exist within the organizational designs of the county, city, and independent fire district?
4. If ISAs do exist, why were they created?

To implement the research methodology, the subsequent chapter analyzes the research questions using the statistical software package IBM SPSS Statistics. Additionally, the results of the face-to-face interviews are discussed in Chapter IV, as confirmation to support, or not support, scale economies per organization type.

Chapter IV begins with a discussion of the sample and unit of analysis, followed by basic descriptive data. The second component tests the sample for normality using appropriate procedures, followed by multiple regression analysis. The last sections of Chapter IV discuss the interviews and further exploratory investigation.

CHAPTER IV. DATA ANALYSIS

Chapter 4 provides the reader with an in-depth statistical analysis of the various fire department organization types, coupled with review of the research questions. Moreover, the face-to-face interviews are intertwined within this chapter to provide a contextual depth not achieved solely with statistical analyses. The chapter consists of the following sections: (a) sample description, (b) descriptive analyses, (c) normality and probability plots, (d) multiple regression analyses, (e) qualitative findings, and (f) further exploratory investigation.

Sample Description

As discussed earlier, to keep anonymity throughout the paper, a detailed and thorough sample description is not possible; however, the following characteristics provide the reader with pertinent information related to the specific fire departments. The unit of analysis is the fire department organization type which includes the county, city, and ISFCD.

County Fire Department

Prior to becoming a consolidated fire/EMS agency, fire protection in a portion of this county was provided by numerous independent special fire control districts. During a 10-year interval, fire districts merged into a county-wide fire department. Within this county agency, fire protection services are provided to a specific geo-spatial boundary, while, EMS are provided to the entire county population, including the city and ISFCD agencies. Table 3 provides a synopsis of the county fire department attributes and shows,

that from 2004-2014, annual budget expenditures increased over 50% while annual service calls increased over 34%. The budget expenditures analyzed for all fire departments exclude capital purchases, principal/debt payments, and intergovernmental transfers.

Table 3

County Fire Department Attributes

Year	Annual Service Calls	Annual Expenditures	Fire Stations	Apparatus	Personnel	Square Miles Protected	Permanent Population
2004	20,127	$21,648,595	16	27	170	693	137,541
2005	21,336	$23,902,509	16	30	172	693	137,019
2006	22,208	$26,274,282	16	34	188	693	139,539
2007	22,356	$29,414,295	16	38	207	693	142,781
2008	22,773	$33,264,859	16	38	205	693	142,761
2009	24,186	$31,073,096	16	38	201	693	142,871
2010	25,379	$30,055,967	16	39	195	693	142,625
2011	26,065	$29,414,146	16	40	202	693	142,760
2012	27,076	$31,922,298	16	43	198	693	146,180
2013	27,121	$29,600,736	16	44	214	693	146,330
2014	26,889	$32,449,423	16	47	215	693	147,118

City Fire Department

Within the same county resides a city fire department that provides fire protection services to its residents within a specific geographical border. The city became incorporated over 100 years ago and at that time its fire protection services were provided with volunteers. Today the fire department is a career paid organization with a small complement of volunteers assisting with public education, special details, and community emergency response teams (CERT). The fire chief reports directly to a city manager, and the city manager reports directly to the elected city commissioners. Table 4 provides a

synopsis of the city fire department attributes. As the table shows, from 2004-2014, annual budget expenditures increased over 69% while annual service calls increased over 13%.

Table 4

City Fire Department Attributes

Year	Annual Service Calls	Annual Expenditures	Fire Stations	Apparatus	Personnel	Square Miles Protected	Permanent Population
2004	2,854	$1,912,006	3	5	24	21	17,168
2005	2,694	$2,098,684	3	5	24	21	16,255
2006	2,741	$2,348,431	3	5	24	21	16,952
2007	2,800	$2,622,935	3	5	24	21	17,302
2008	2,778	$2,776,058	3	5	24	21	17,651
2009	2,968	$2,668,057	3	5	24	21	16,989
2010	3,160	$2,728,738	3	5	24	21	17,353
2011	3,031	$2,308,498	3	5	24	21	17,703
2012	3,183	$3,042,080	3	5	24	21	17,177
2013	3,184	$3,098,626	3	5	24	21	17,349
2014	3,224	$3,227,715	3	5	24	21	17,349

Independent Special Fire Control District

Within the same county resides an ISFCD that provides fire protection services to its residents within a specific geographical border. The ISFCD is a separate organization not under the auspices of county or city government. The ISFCD fire chief reports directly to five elected fire commissioners that represent certain geographical boundaries within the district. The ISFCD receives its constitutional and legislative authority through Florida State Statute Chapters 189 and 191 and operates under a district charter. Table 5 provides a synopsis of the ISFCD attributes. As the table indicates, from 2004-2014,

annual budget expenditures increased over 76% while annual service calls increased over 28%.

Table 5

Independent Special Fire Control District Attributes

Year	Annual Service Calls	Annual Expenditures	Fire Stations	Apparatus	Personnel	Square Miles Protected	Permanent Population
2004	2,210	$3,782,725	4	4	58	83	48,000
2005	2,287	$4,472,499	4	4	58	83	48,000
2006	2,301	$5,051,867	4	4	63	83	48,000
2007	2,270	$6,295,001	4	4	63	83	48,000
2008	2,250	$6,614,245	4	4	63	83	48,000
2009	2,601	$6,737,993	5	5	63	83	48,000
2010	2,650	$6,785,558	6	6	59	83	48,000
2011	2,801	$7,063,419	6	7	56	83	48,000
2012	2,750	$7,596,670	6	7	54	83	48,000
2013	2,757	$6,889,334	6	7	54	83	48,000
2014	2,819	$6,642,044	6	6	54	83	48,000

County-wide Average Figures

The county on average responds quarterly to over 5,293 and 5,405 more emergency service calls than the city and ISFCD; however, the county's average quarterly cost to respond to their emergency service calls cost $265 more than the city and $1,302 less than the ISFCD. From a daily cost per emergency response perspective, the county costs $201 more than the city and $174 more than the ISFCD to operate. From a cost per square mile perspective, on average the city costs $21,584 and $13,445 more than the county and ISFCD, respectively. Lastly, based solely on the number of annual emergency responses and not taking into account emergency type, the ISFCD costs more to operate; however, its cost per capita is less than the county and city by $24 and $15,

respectively. Table 6 provides an overview of the quarterly county-wide fire departments' average operational costs and emergency service calls covering an 11-year period.

Table 6

Quarterly Average Costs for the County, City, and ISFCD for FY 2004-2014

Fiscal Years 2004-2014	County	City	ISFCD
Emergency Service Calls	6,034	741	629
Expenditures	$7,250,459	$666,580	$1,543,749
Cost per Square Mile	$10,462	$32,046	$18,601
Cost per Capita	$47	$38	$23
Operational Cost	$80,561	$7,477	$17,154
Cost per Emergency Response	$1,205	$940	$2,507

Descriptive Statistics

Descriptive Statistics for Quarterly Expenditures

Along with computing descriptive statistics, histograms also are presented. A histogram provides a graphical representation of the value distributions, and suggests which summary variables might be useful. Figures 2, 3, and 4 are histograms of the county, city, and ISFCD quarterly expenditures for an 11-year period covering 44 data points. Expenditures, as shown in Table 7, represent all costs required to operate the respective fire departments. These costs include personnel, benefits/insurance, operational, maintenance, training, supplies, and interjurisdictional payments.

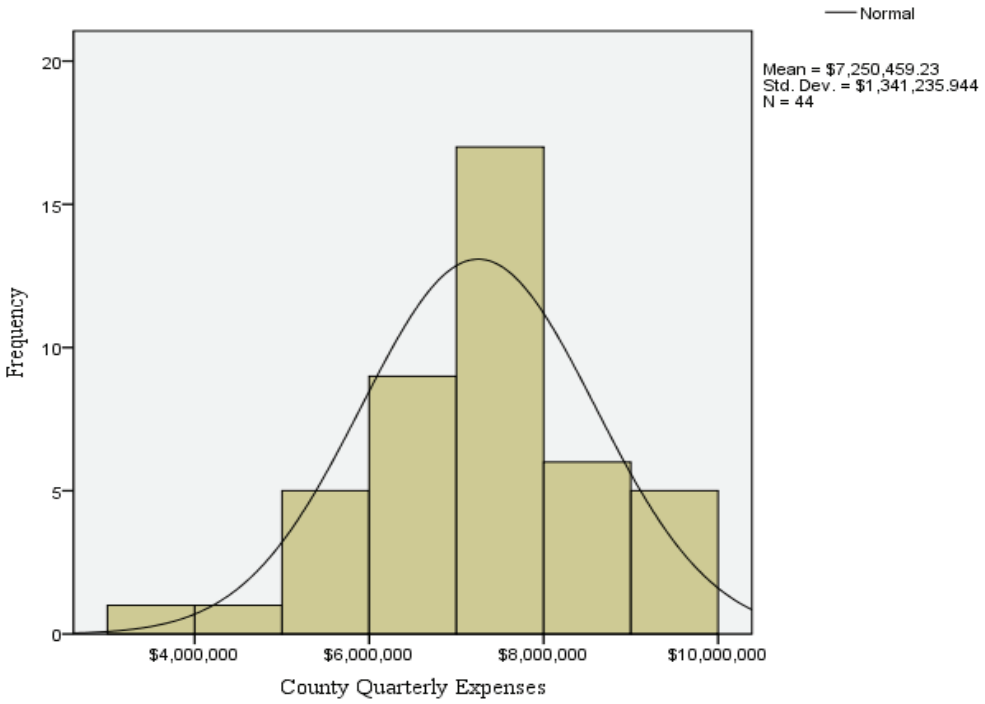


Figure 2. Histogram of County Fire/EMS Quarterly Expenditures FY 2004-2014.

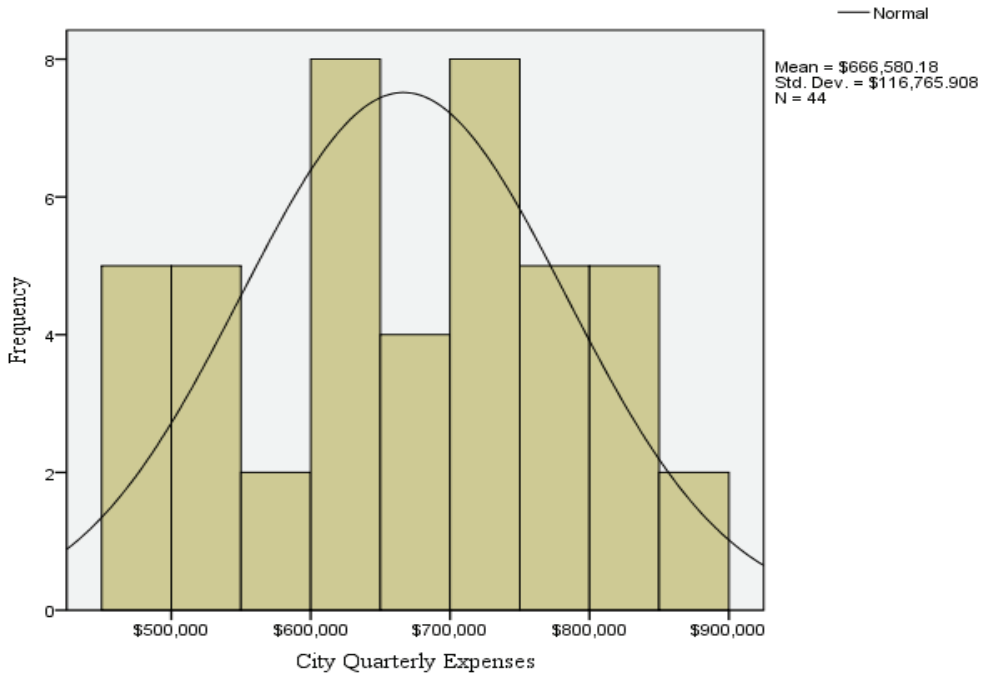


Figure 3. Histogram of City Fire/EMS Quarterly Expenditures FY 2004-2014.

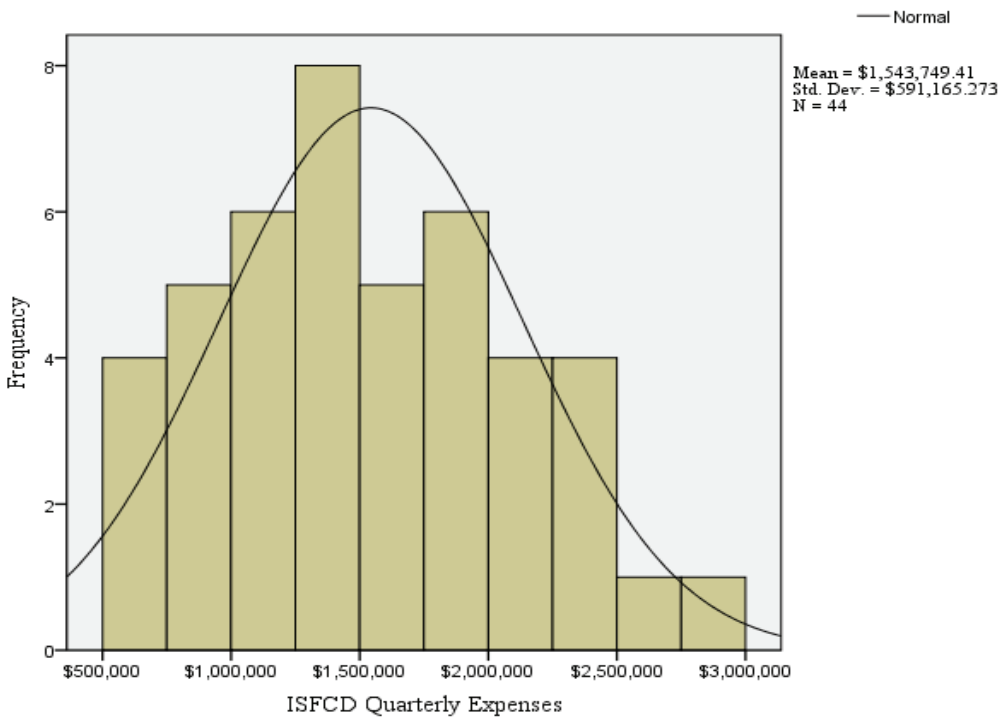


Figure 4. Histogram of ISCFD Quarterly Expenditures FY 2004-2014.

Table 7

Descriptive Statistic Summary for Quarterly Expenditures FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$3,815,704	$9,928,396	$7,250,459	$1,341,235
City	44	$450,625	$875,774	$666,580	$116,765
ISFCD	44	$536,199	$2,963,589	$1,543,749	$591,165
Valid *N* (listwise)	44				

Descriptive Statistics for Quarterly Emergency Service Calls

The quarterly emergency service call variable is the genesis for measuring output and cost-related activities within fire/EMS organizations. To track emergency service calls across U.S. fire and EMS agencies, the U.S. Fire Administration (USFA), as a

branch within the Department of Homeland Security's Federal Emergency Management Agency, has a federal recording repository. This federal recording repository is the National Fire Incident Reporting System (NFIRS) where individual, local fire departments can upload all emergency service calls (e.g., fire, EMS, hazardous materials, false calls, public assists, etc.) into the uniform standardized reporting system for data collection and assimilation (USFA, 2016).

For this research, the emergency service call variable included all service calls responded to by the respective agency as depicted in Figures 5, 6, and 7, and Table 8. The variable presented is without regard for emergency call type. The reason for not regarding call type is indicative of today's fire service as an all-hazard emergency response provider. Today's fire service, as reported in the June 2015 USFA report *Operational Lessons Learned in Disaster Response,* is the agency of last resort. As the agency of last resort when community infrastructure is collapsing, the budgetary allocations previously presented represent the fire departments being in a state of constant readiness and preparedness. Though emergency service call type is important, this research does not analyze specific call type as "[A]ll-hazard responses represent some of the most difficult and complex challenges in public safety" (USFA, 2015, p. 1). Some of the incidents in this category include "hurricanes, floods, tornadoes, urban-wildland fires, hazardous material releases, communicable disease outbreaks, animal disease outbreaks, terrorist attacks, and search and technical rescue operations" (USFA, 2015, p. 1).

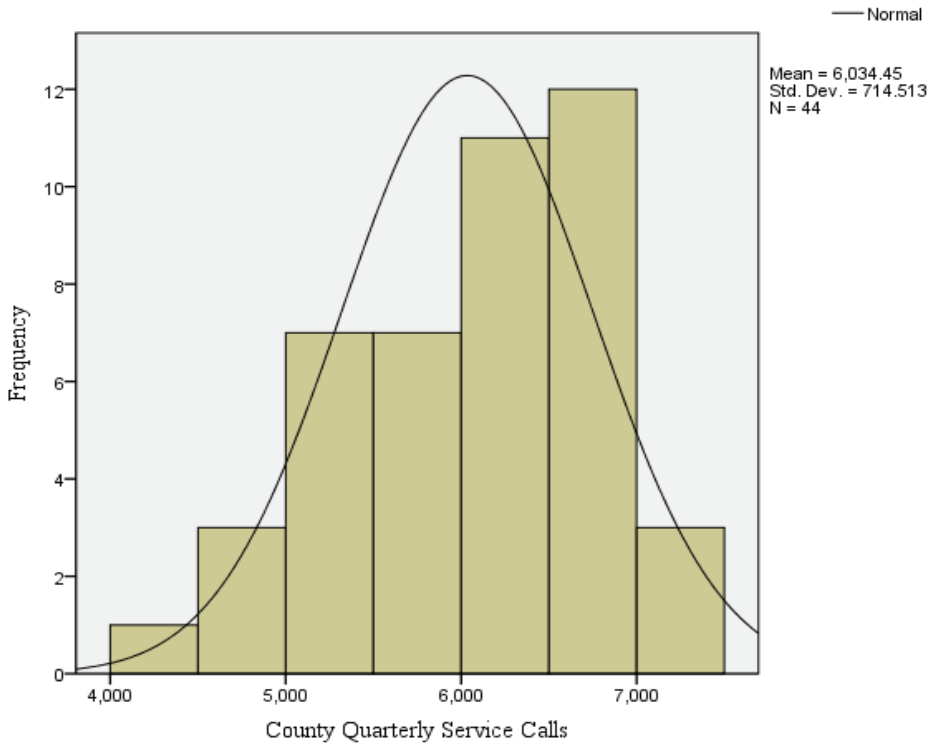


Figure 5. Histogram of County Quarterly Emergency Service Calls FY 2004-2014.

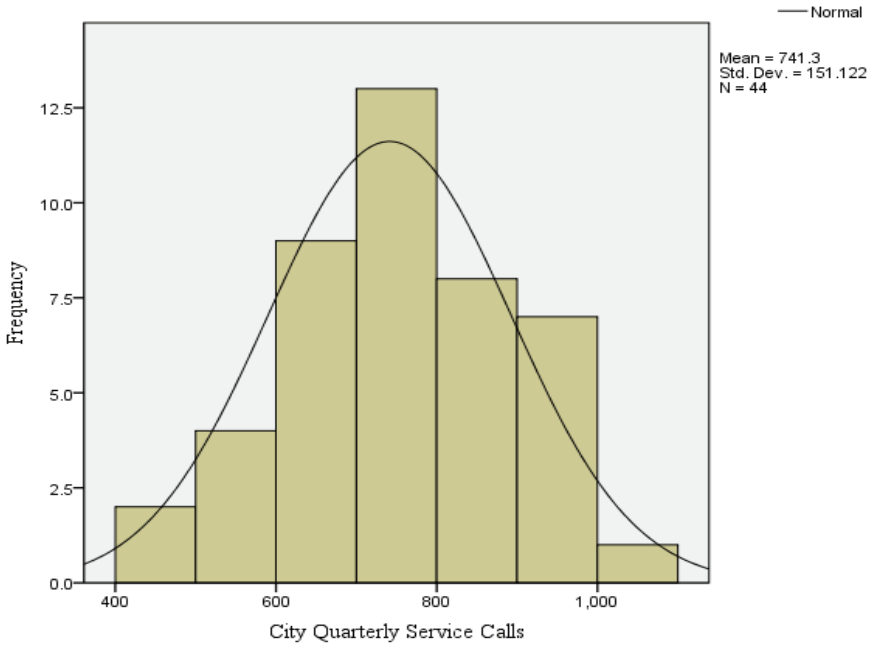


Figure 6. Histogram of City Quarterly Emergency Service Calls FY 2004-2014.

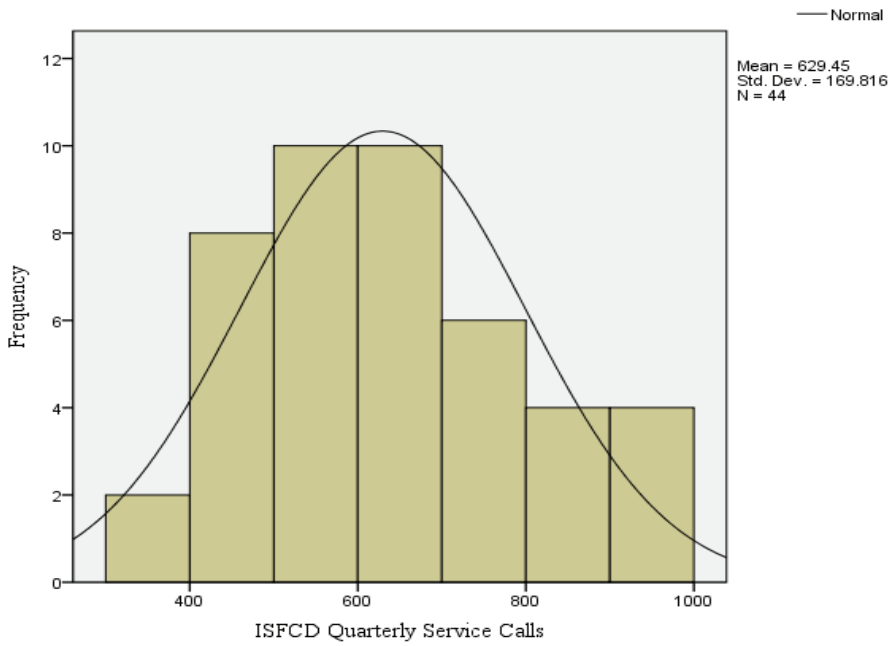


Figure 7. Histogram of ISFCD Quarterly Emergency Service Calls FY 2004-2014.

Table 8

Descriptive Statistic Summary for Quarterly Emergency Service Calls FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	4,295	7,050	6,034.45	714.513
City	44	400	1,000	741.30	151.122
ISFCD	44	376	985	629.45	169.816
Valid *N* (listwise)	44				

The results reported in Table 9 begin to highlight important attribute differences among the organizational designs. Surmising from the table, the assumption is made that the average daily cost to operate the ISFCD is higher than the city but not the county, the average cost per response is higher for the ISFCD, and the average daily cost per emergency service call is higher for the ISFCD. In essence, the assumption from the table

is the centralized county costs more than the ISFCD and city designs to remain in a constant state of preparedness and readiness, while the ISFCD costs more than the city design. Based on the design attributes, as previously displayed in Tables 3, 4, and 5, the organizational design ordering results to remain in a constant state of preparedness and readiness appears reasonable.

Table 9

Descriptive Statistic Summary for Quarterly Emergency Service Calls and Quarterly Expenditures FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County Service Calls	44	4,295	7,050	6,034.45	714.513
City Service Calls	44	400	1,000	741.30	151.122
ISFCD Service Calls	44	376	985	629.45	169.816
County Expenditures	44	$3,815,704	$9,928,396	$7,250,459	$1,341,235
City Expenditures	44	$450,625	$875,774	$666,580	$116,765
ISFCD Expenditures	44	$536,199	$2,963,589	$1,543,749	$591,165
Valid *N* (listwise)	44				

Figures 8, 10, and 12 show the annual trends in emergency service calls versus annual expenditures. Figures 9, 11, and 13 show quarterly trends in average cost per emergency service calls versus average costs per capita.

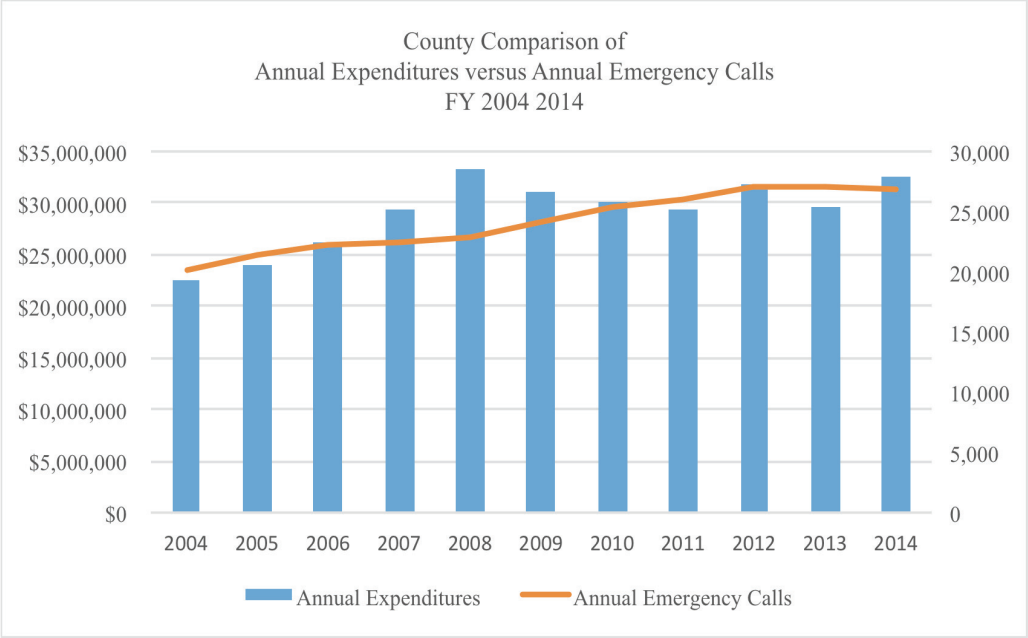


Figure 8. County Fire/EMS Emergency Service Calls versus Annual Expenditures.

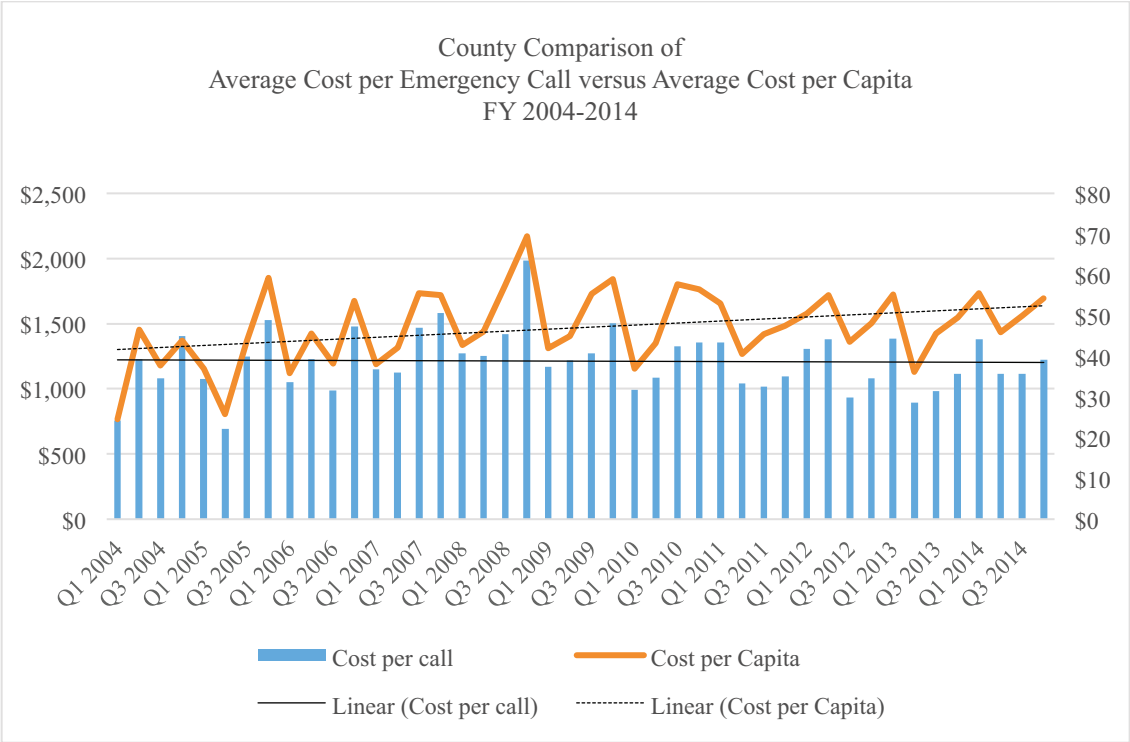


Figure 9. County Average Cost per Service Call versus Average Cost per Capita.

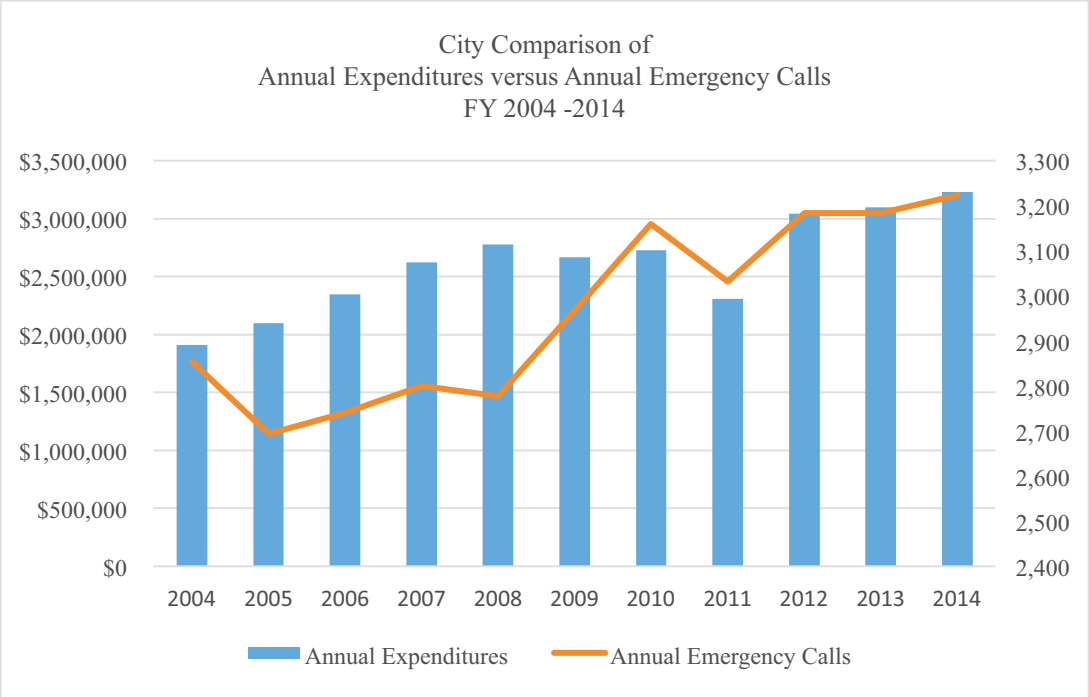


Figure 10. City Fire/EMS Emergency Service Calls versus Annual Expenditures.

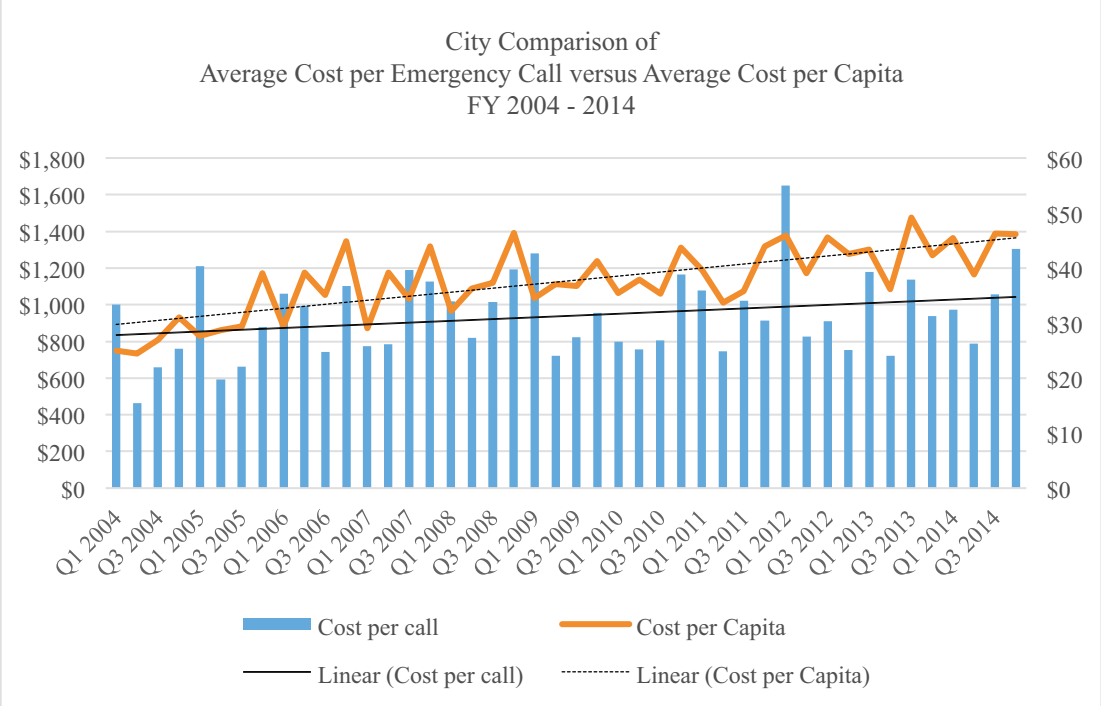


Figure 11. City Average Cost per Service Call versus Average Cost per Capita.

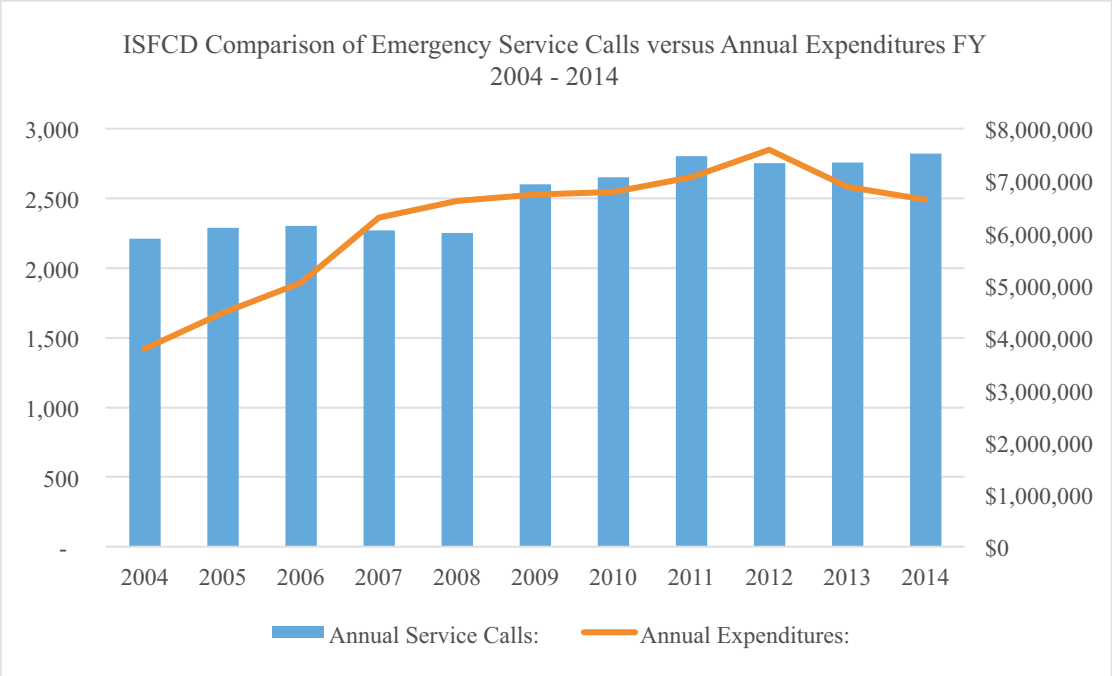


Figure 12. ISFCD Fire/EMS Emergency Service Calls versus Annual Expenditures.

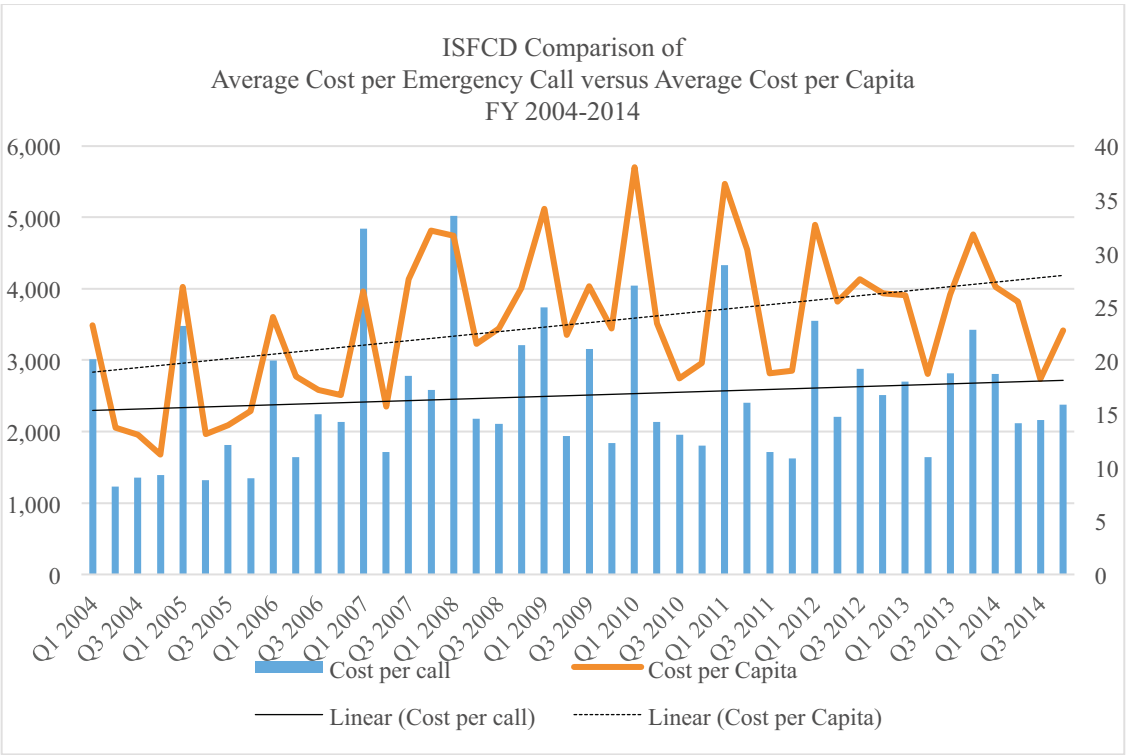


Figure 13. ISFCD Average Cost per Service Call versus Average Cost per Capita.

From the three organizational designs, the county and ISFCD figures appear to achieve economies of scale more than the city. As displayed in Figure 8, the county's overall cost to provide fire/EMS services follows an increasing linear pattern, except for FYs 2007-2008, 2011, and 2013. As displayed in Figure 10, the city's overall cost to provide fire/EMS services shows an increasing expenditure pattern as emergency service calls decrease, with a normalization of costs to service calls in the later FYs. As displayed in Figure 12, the ISFCD overall cost to provide fire/EMS services increases as service calls stabilize, then expenditures stabilize as service calls slightly increase.

The reason for the cost per call spikes in Figure 13 is due to the nature of certain costs being expended every first quarter of the new fiscal year. This was confirmed by the fire chief who indicated that, in the first quarter of every new fiscal year, certain recurring labor/contractual personnel costs are paid, coupled with various national protection fire association standards that the department complies with regarding fire standards and safety compliance. Similar cost spikes occur in Figures 9 and 11 due to repair and maintenance and personnel associated expenditures and number of quarterly service calls, respectively.

On average, as Table 9 shows, the city fire department responds to 112 more emergency service calls quarterly than the ISFCD; however, the average quarterly ISFCD budgetary expenditures exceed the city by $877,169. The larger ISFCD expenditure base makes sense due to the larger attributes associated with the fire department. Under the centralized/consolidated county design, the county fire fighters respond to over 10 times more emergency service calls quarterly than the decentralized city and ISFCD designs, while their average expenditures are eleven and five times greater, respectively.

As Table 10 depicts, from FY 2004-2014, the county requires an average of $73,276 - $63,600 more to operate over a 90-day period. Table 11 reveals that, on average, from FY 2004 -2014, the ISFCD cost for responding to all emergency service calls is higher than the city and county by $1,567 and $1,294, respectively. Table 12 reveals that, on average, from FY 2004-2014, the ISFCD costs $4.29 and $3.57 more than the city and county, respectively, to respond on a daily basis to emergency service calls.

Table 10

Descriptive Statistic Summary for Quarterly Daily Operational Costs FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$42,397	$110,316	$80,752.93	$14,863.234
City	44	$5,007	$9,731	$7,477.45	$1,296.354
ISFCD	44	$5,958	$32,929	$17,152.77	$6,568.503
Valid *N* (listwise)	44				

From Tables 11 and 12, the ISFCD seems to have higher per capita costs than the city and county, coupled with higher operating costs per emergency service response.

Table 11

Descriptive Statistic Summary for Quarterly Daily Cost per Emergency Service Response FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$691	$1,986	$1,212.50	$232.237
City	44	$465	$1,651	$939.61	$224.549
ISFCD	44	$1,232	$5,021	$2,506.57	$930.684
Valid *N* (listwise)	44				

Table 12

Descriptive Statistic Summary for Annual Daily Cost per Emergency Service Response FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$2.01	$4.95	$3.3007	$0.58026
City	44	$1.27	$4.52	$2.5748	$0.61516
ISFCD	44	$3.38	$13.76	$6.8686	$2.54875
Valid *N* (listwise)	44				

As Table 13 displays, the ISFCD has lower average per capita costs than the city and county fire departments by $15 and $24 respectively. As Table 14 shows, the ISFCD is able to service and protect its jurisdictional boundaries for an average of $13,447 less than the city, and the county's average protection cost per square mile is less than the city and ISFCD by $21,559 and $8,112, respectively.

Table 13

Descriptive Statistic Summary for Quarterly Cost per Capita FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$24	$70	$47.05	$8.996
City	44	$24	$49	$37.57	$6.471
ISFCD	44	$11	$38	$23.39	$6.620
Valid *N* (listwise)	44				

Table 14

Descriptive Statistic Summary for Quarterly Cost per Jurisdiction Square Mile FY 2004-2014

Unit	*N*	Minimum	Maximum	*M*	*SD*
County	44	$5,506	$14,327	$10,487.34	$1,930.267
City	44	$21,458	$41,704	$32,046.43	$5,555.730
ISFCD	44	$6,460	$35,706	$18,599.45	$7,122.546
Valid *N* (listwise)	44				

Norusis (2008a) noted that scatterplots are one of the best ways to understand relationships and patterns among dependent and independent variables, and are the first step of regression analysis. Moreover, Knapp (2014) asserted satisfying linearity, homoscedasticity, and correlation assumptions are paramount for regression modeling. Hence, the following two sections analyze the stated assumptions.

Correlation Matrices and Variable Plotting

Figure 14 shows positive relationships for all variables presented, but the relationship among the independent variable, county fire apparatus, and dependent variable, county emergency service calls, appears to show a strong linear relationship, which is confirmed in Table 15. Another strong linear relationship is displayed among the dependent variable, county emergency service calls, and the independent variables, County population and personnel. The vertical constant line attributed to county square miles and fire stations stems from the value not changing over the fiscal year time periods.

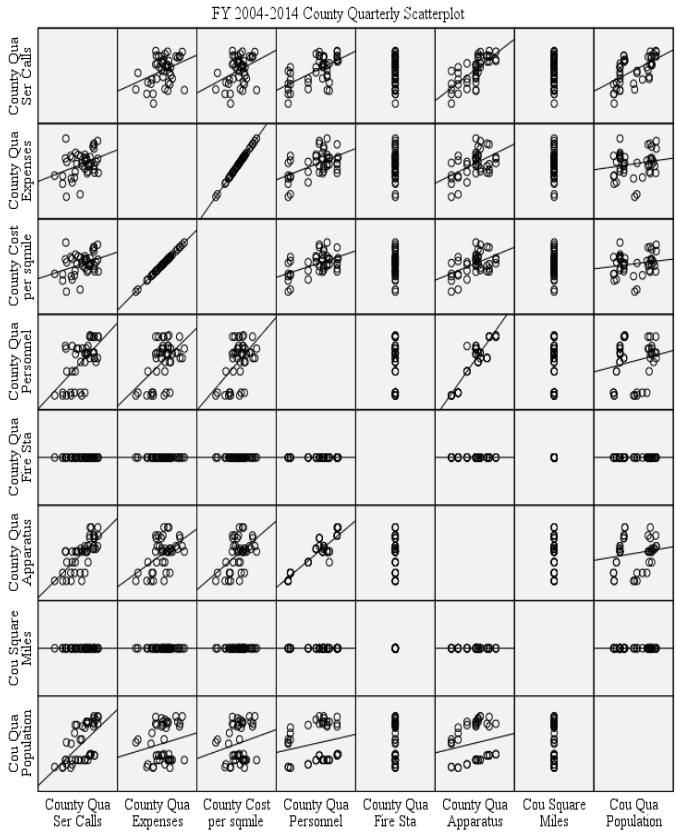


Figure 14. Scatterplot Matrices for County Fire Variables - FY 2004 – 2014.

Table 15 shows the Pearson correlation coefficients of the county fire variables that are used in the regression model. This measures the actual values of the variables within a range of -1 to +1. The positive correlation between fire apparatus and emergency service call possesses a .733 coefficient with a statistical significance at the 0.01 level ($p < .001$). The fire apparatus and personnel variables possess a .911 correlation coefficient with a statistical significance at the .001 level. Hence, as shown in Figure 14, these variables are viable predictors and possess a strong positive association. Interestingly, quarterly population and quarterly expenses are not statistically significant at the 0.01 level and possess a correlation of .176. Hence, one cannot predict with great certainty that expenses are associated with population, as shown in Figure 14.

Figure 15 shows positive relationships for two of the variables presented, but the relationship among the dependent variable, city emergency calls for service, and independent variable, city quarterly population, shows the strongest linear relationship, and this is confirmed in Table 16. The two variables as presented in Table 16 possess a .317 correlation and is statistically significant at the .05 level. The service call variable against quarterly expenses is not statistically significant; however, they possess a positive correlation of .254 and appear not to violate the homoscedasticity criterion as displayed in Figure 14 (i.e., the density of the points remains in the middle of the line and tapers off at the ends). The reason for perfect vertical and horizontal lines among certain variables is because of the constant value of personnel, square miles, apparatus, and fire stations over the 44 fiscal quarters.

Table 15

Multivariate Pearson Correlation Coefficients of County Fire FY 2004-2014

		Quarterly Service Calls	Quarterly Expenses	Quarterly Personnel	Quarterly Fire Stations	Quarterly Fire Apparatus	Square Miles	Quarterly Population
Quarterly Service Calls	Pearson Correlation	1	.353*	**.610****	***	**.733****	***	**.588****
	Sig.(2-tailed)		.019	.000	.	.000	.	.000
	N	44	44	44	44	44	44	44
Quarterly Expenses	Pearson Correlation	.353*	1	.519**	***	.500**	***	.176
	Sig.(2-tailed)	.019		.000	.	.001	.	.252
	N	44	44	44	44	44	44	44
Quarterly Personnel	Pearson Correlation	.610**	.519**	1	***	.911**	***	.206
	Sig.(2-tailed)	.000	.000		.	.000	.	.180
	N	44	44	44	44	44	44	44
Quarterly Fire Stations	Pearson Correlation	***	***	***	***	***	***	***
	Sig.(2-tailed)	.	.	.		.	.	.
	N	44	44	44	44	44	44	44
Quarterly Apparatus	Pearson Correlation	.733**	.500**	.911**	***	1	***	.170
	Sig.(2-tailed)	.000	.001	.000	.		.	.269
	N	44	44	44	44	44	44	44
Square Miles	Pearson Correlation	***	***	***	***	***	***	***
	Sig.(2-tailed)	.	.	.	.	.		.
	N	44	44	44	44	44	44	44
Quarterly Population	Pearson Correlation	.588**	.176	.206	***	.170	***	1
	Sig.(2-tailed)	.000	.252	.180	.	.269	.	
	N	44	44	44	44	44	44	44

Note. *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
***. Cannot be computed because at least one of the variables is constant.

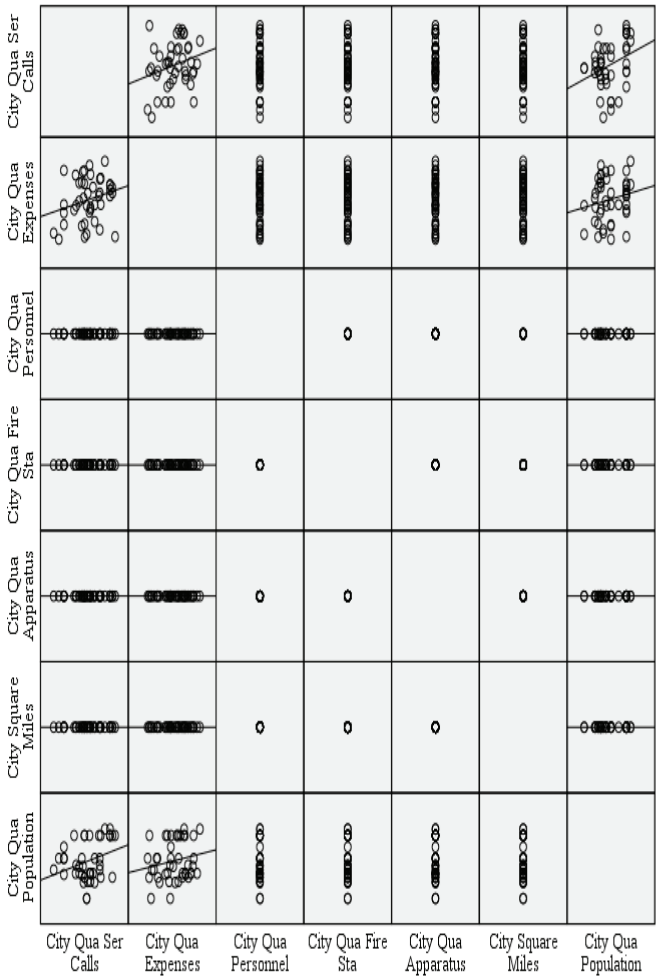


Figure 15. Scatterplot Matrices for City Fire Variables Covering FY 2004 – 2014.

Table 16

Multivariate Pearson Correlation Coefficients of City Fire FY 2004-2014

		Quarterly Service Calls	Quarterly Expenses	Quarterly Personnel	Quarterly Fire Stations	Quarterly Fire Apparatus	Square Miles	Quarterly Population
Quarterly Service Calls	Pearson Correlation	1	**.254**	**	**	**	**	**.317***
	Sig.(2-tailed)		**.096**	.	.	.	.	**.036**
	N	44	**44**	44	44	44	44	**44**
Quarterly Expenses	Pearson Correlation	.254	1	**	**	**	**	.190
	Sig.(2-tailed)	.096		.	.	.	.	.216
	N	44	44	44	44	44	44	44
Quarterly Personnel	Pearson Correlation	**	**	**	**	**	**	**
	Sig.(2-tailed)	.	.		.	.	.	.
	N	44	44	44	44	44	44	44
Quarterly Fire Stations	Pearson Correlation	**	**	**	**	**	**	**
	Sig.(2-tailed)	.	.	.		.	.	.
	N	44	44	44	44	44	44	44
Quarterly Apparatus	Pearson Correlation	**	**	**	**	**	**	**
	Sig.(2-tailed)	.	.	.	.		.	.
	N	44	44	44	44	44	44	44
Square Miles	Pearson Correlation	**	**	**	**	**	**	**
	Sig.(2-tailed)	.	.	.	.	.		.
	N	44	44	44	44	44	44	44
Quarterly Population	Pearson Correlation	.317*	.190	**	**	**	**	1
	Sig.(2-tailed)	.036	.216	.	.	.	.	
	N	44	44	44	44	44	44	44

Note. *. Correlation is significant at the 0.05 level (2-tailed).
**. Cannot be computed because at least one of the variables is constant.

Figure 16 displays the strongest linear relationship between the independent variable, population, and dependent variable, service calls. This correlation is confirmed in Table 17 as the coefficient .747 is statistically significant at the .01 level. Second, the independent variable, service calls, shows a positive relationship with the dependent variable, expenses, as shown in the figure and confirmed in the table, with a .446 correlation coefficient. There are five negative linear relationships showing in the figure. It appears apparatus and personnel, population and personnel, fire stations and personnel, and service calls and personnel are negatively correlated. These negative linear associations are confirmed in the table, along with their statistical significance at the .01 and .05 levels. The table confirms what is shown in Table 5. For example, as apparatus levels increase, personnel decrease; hence the correlation coefficient of -.686.

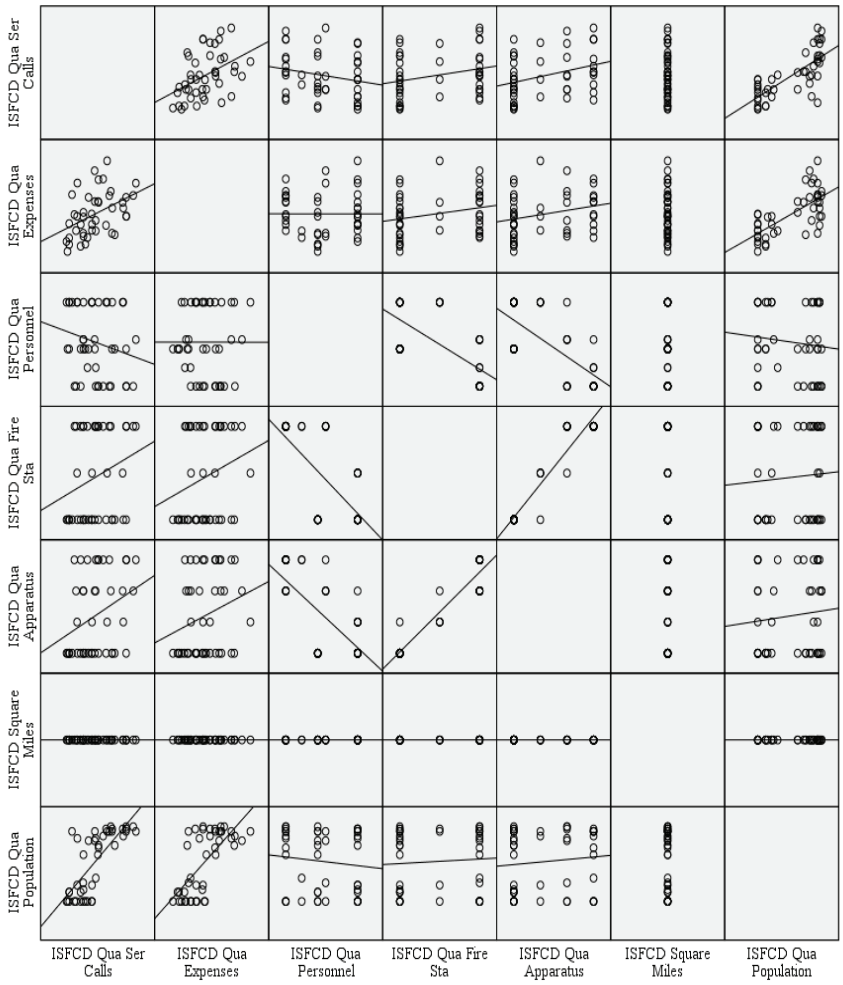


Figure 16. Scatterplot Matrices for ISFCD Fire Variables Covering FY 2004 -2014.

Table 17

Multivariate Pearson Correlation Coefficients of ISFCD FY 2004-2014

		Quarterly Service Calls	Quarterly Expenses	Quarterly Personnel	Quarterly Fire Stations	Quarterly Fire Apparatus	Square Miles	Quarterly Population
Quarterly Service Calls	Pearson Correlation	1	.446**	-.212	.263	.329*	***	.747**
	Sig.(2-tailed)		.002	.168	.085	.029	.	.000
	N	44	44	44	44	44	44	44
Quarterly Expenses	Pearson Correlation	.446**	1	**-.001**	.245	.254	.690**	***
	Sig.(2-tailed)	.002		**.997**	.110	.096	.000	.
	N	44	44	**44**	44	44	44	44
Quarterly Personnel	Pearson Correlation	**-.212**	-.001	1	-.693**	**-.686****	**-.115**	***
	Sig.(2-tailed)	**.168**	.997		.000	**.000**	**.459**	.
	N	**44**	44	44	44	**44**	**44**	44
Quarterly Fire Stations	Pearson Correlation	.263	.245	**-.693****	1	.957**	.070	***
	Sig.(2-tailed)	.085	.110	**.000**		.000	.651	.
	N	44	44	**44**	44	44	44	44
Quarterly Apparatus	Pearson Correlation	.329*	.254	-.686**	.957**	1	.105	***
	Sig.(2-tailed)	.029	.096	.000	.000		.497	.
	N	44	44	44	44	44	44	44
Quarterly Population	Pearson Correlation	**.747****	.690**	-.115	.070	.105	1	***
	Sig.(2-tailed)	**.000**	.000	.459	.651	.497		.
	N	**44**	44	44	44	44	44	44
Square Miles	Pearson Correlation	***	***	***	***	***	***	***
	Sig.(2-tailed)	.	.	.	.	.	.	
	N	44	44	44	44	44	44	44

Note. *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
***. Cannot be computed because at least one of the variables is constant.

Normality and Probability Plots

Q-Q Plots and Normality Tests for Quarterly Expenditures

As displayed in Figures 17, 19, and 21, the points cluster around the straight line, with the observed quarterly expenditures for each organizational design plotted on the x-axis, and the expected values, if the sample is from a normal distribution, plotted on the y-axis. If the observed and expected distributions are perfectly normal, all points would fall on the straight line. As displayed in Figures 18, 20, and 22, the points fall randomly around the 0.0000 band line, indicating the sample is from a normal population (Newton & Rudestam, 1999).

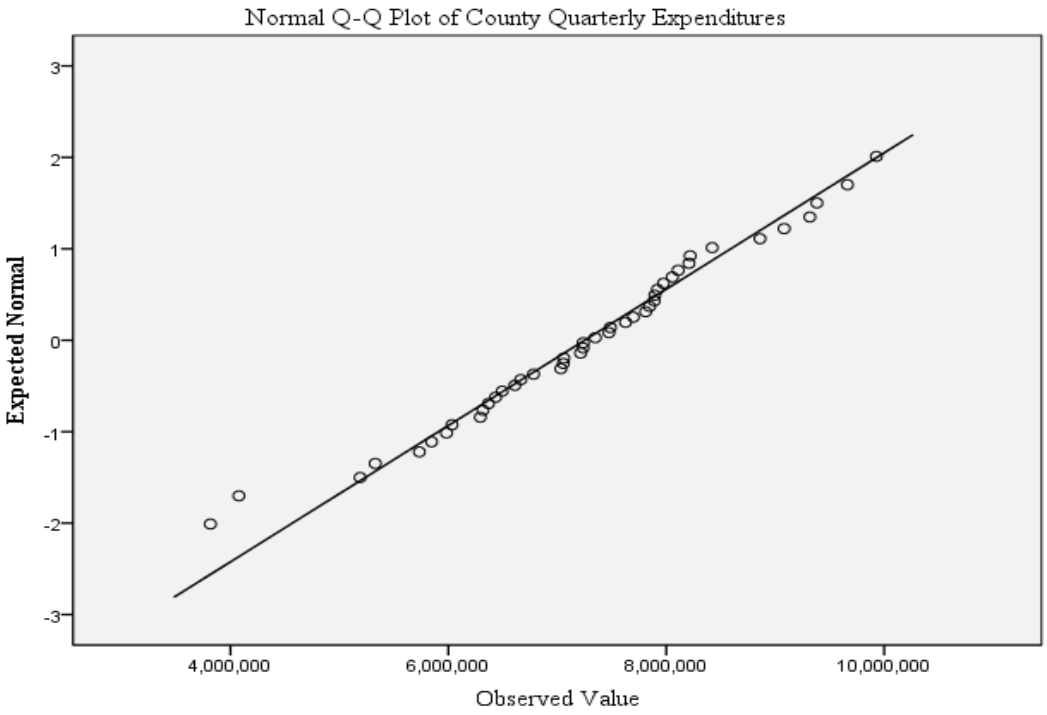


Figure 17. Q-Q Plot of County Quarterly Expenditures.

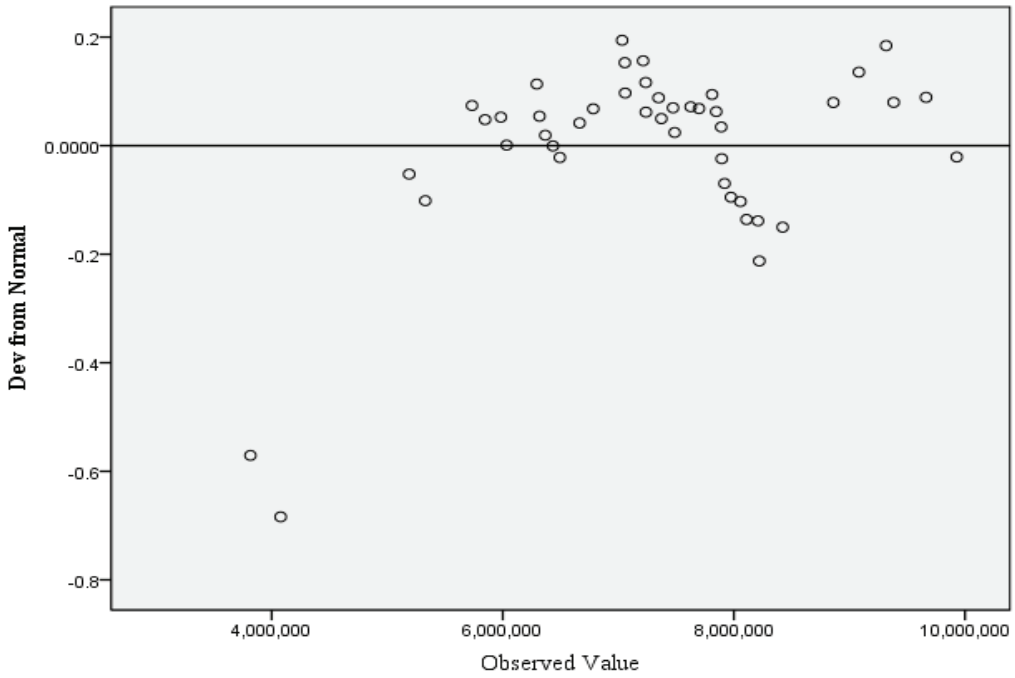


Figure 18. Detrended Normal Q-Q Plot of County Quarterly Expenditure Residuals.

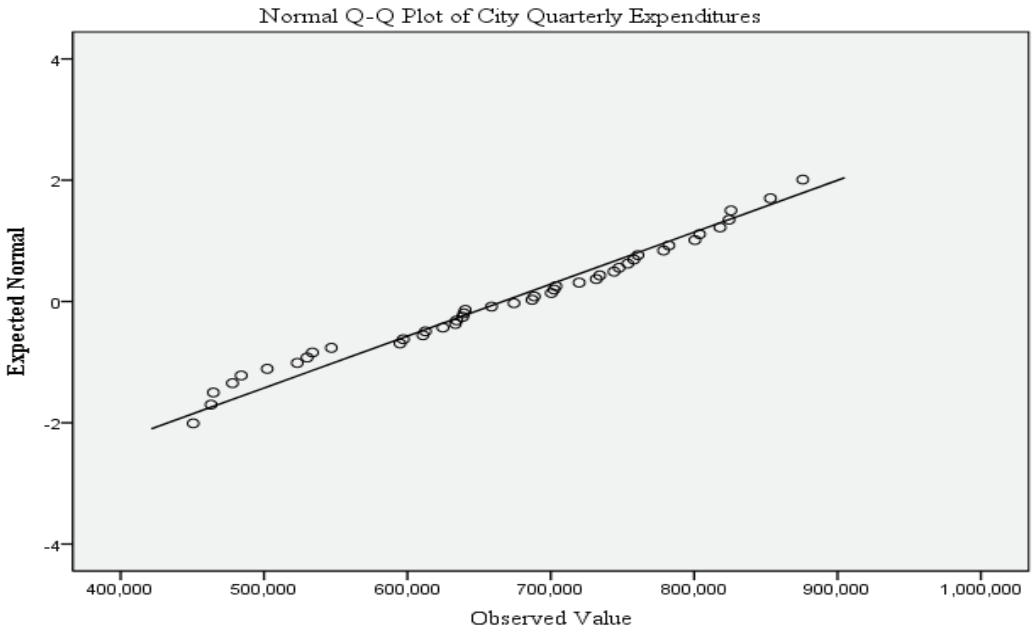


Figure 19. Q-Q Plot of City Quarterly Expenditures.

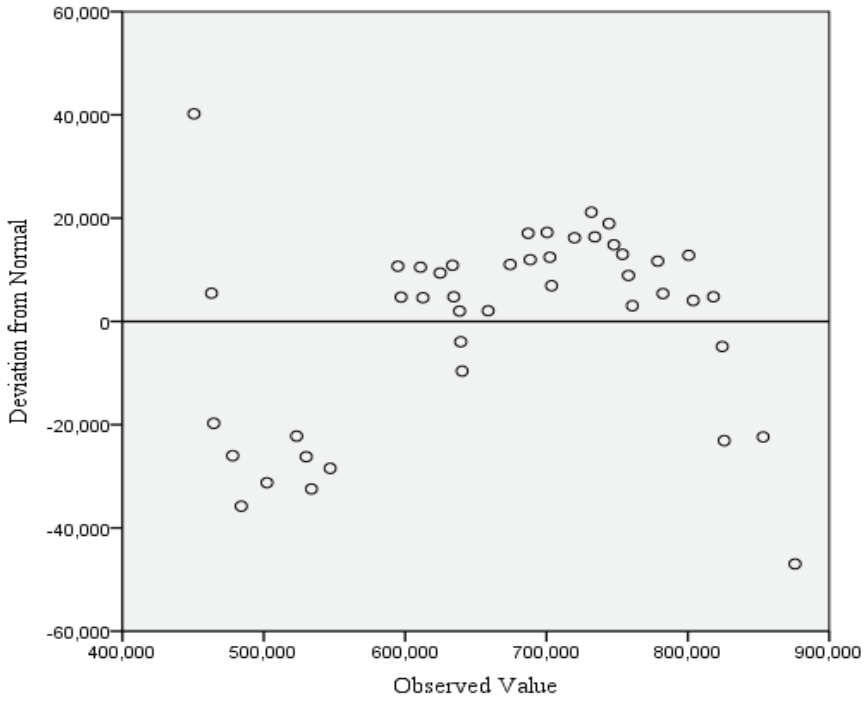


Figure 20. Detrended Normal Q-Q Plot of City Quarterly Expenditure Residuals.

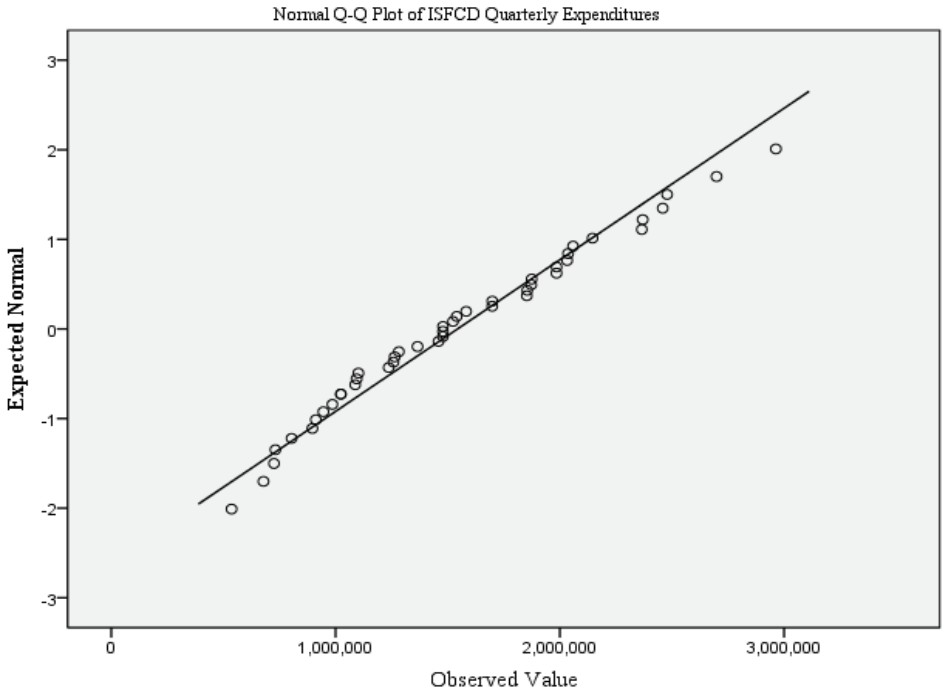


Figure 21. Q-Q Plot of ISFCD Quarterly Expenditures.

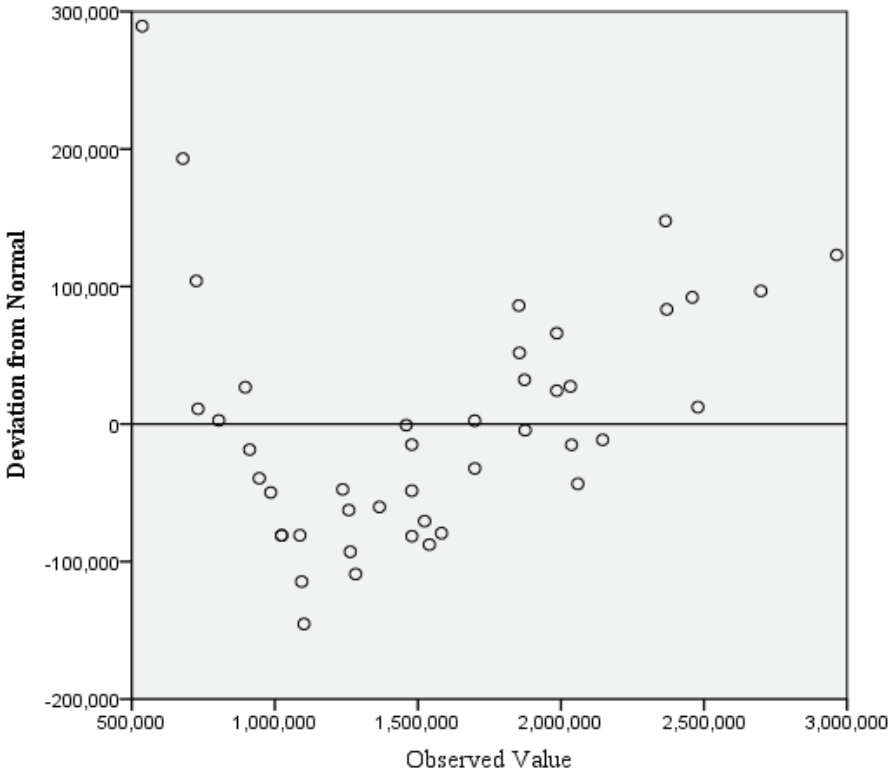


Figure 22. Detrended Normal Q-Q Plot of ISFCD Quarterly Expenditure Residuals.

Table 18 shows that the observed significance levels are relatively large and statistically insignificant for both tests; as such, normality is not an unreasonable assumption.

Table 18

Normality Tests for Quarterly Expenditures

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Unit	Statistic	df	Sig.	Statistic	df	Sig.
County	.076	44	.200*	.980	44	.653
City	.077	44	.200*	.964	44	.190
ISFCD	.091	44	.200*	.973	44	.379

Note. *. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Q-Q Plots and Normality Tests for Quarterly Emergency Service Calls

As displayed in Table 19, the observed significance levels for all organizational designs are large enough to assume the data are a sample from a normal distribution; hence, the null hypothesis of a normal distribution is not rejected. As displayed in Figures 23, 25, and 27, the points cluster around the straight line, with the observed quarterly emergency service calls for each organizational design plotted on the x-axis, and the expected values, if the sample is from a normal distribution, plotted on the y-axis. If the observed and expected distributions are perfectly normal, all points would fall on the straight line. As displayed in Figures 24, 26, and 28, the points fall randomly around the 0.0000 band line, indicating the sample is from a normal population (Newton & Rudestam, 1999).

Table 19

Normality Tests for Quarterly Emergency Service Calls

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Unit	Statistic	df	Sig.	Statistic	df	Sig.
County	.137	44	.037	.946	44	.039
City	.081	44	.200*	.967	44	.236
ISFCD	.094	44	.200*	.954	44	.077

Note. *. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

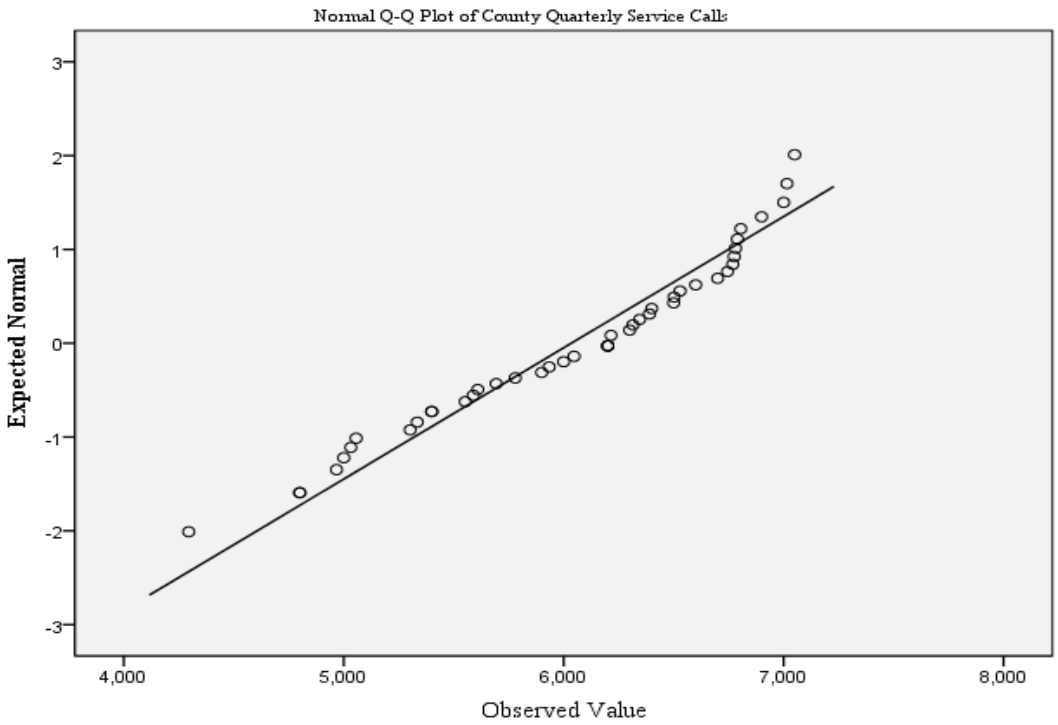


Figure 23. Q-Q Plot of County Quarterly Emergency Service Calls.

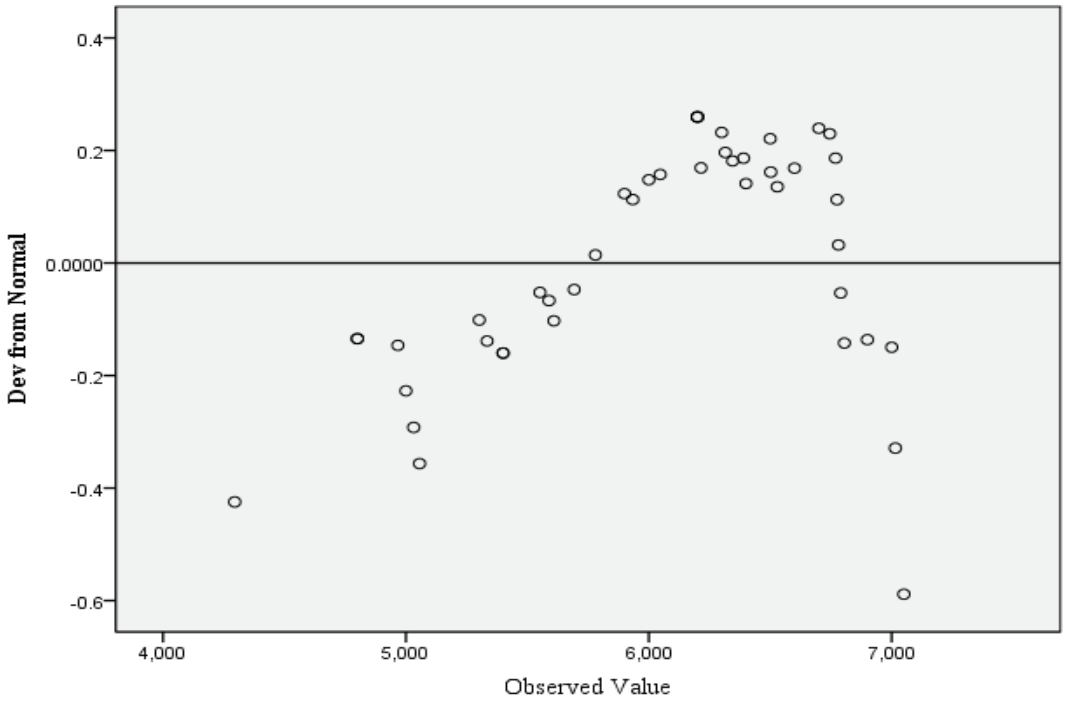


Figure 24. Detrended Normal Q-Q Plot of County Emergency Service Call Residuals.

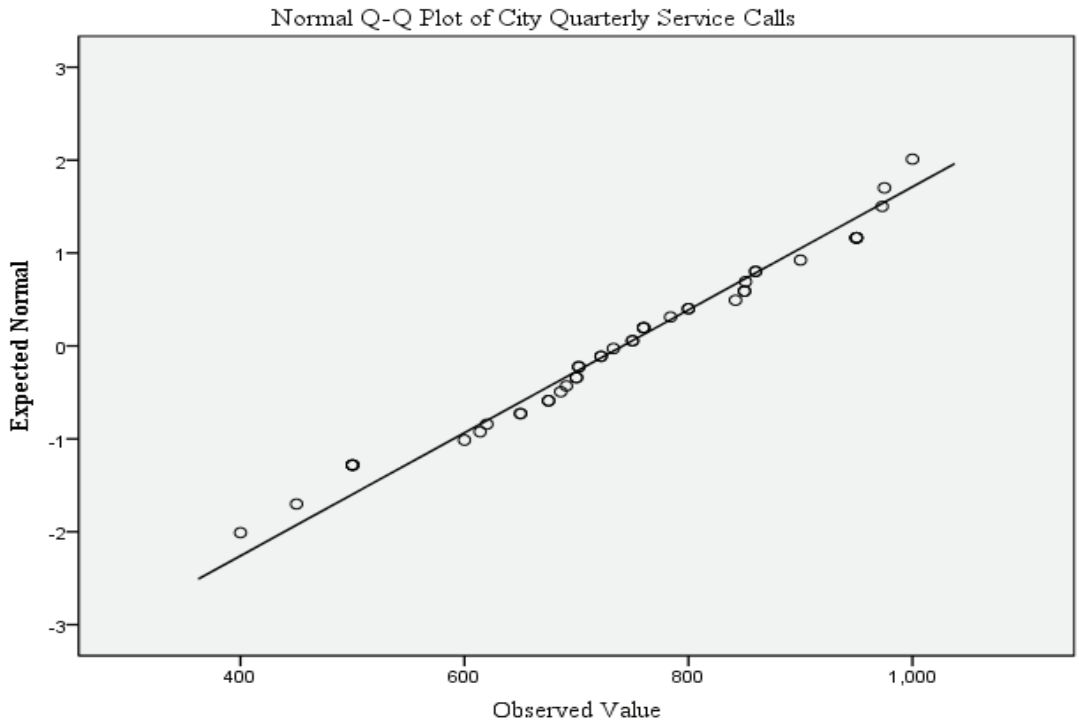


Figure 25. Q-Q Plot of City Quarterly Emergency Service Calls.

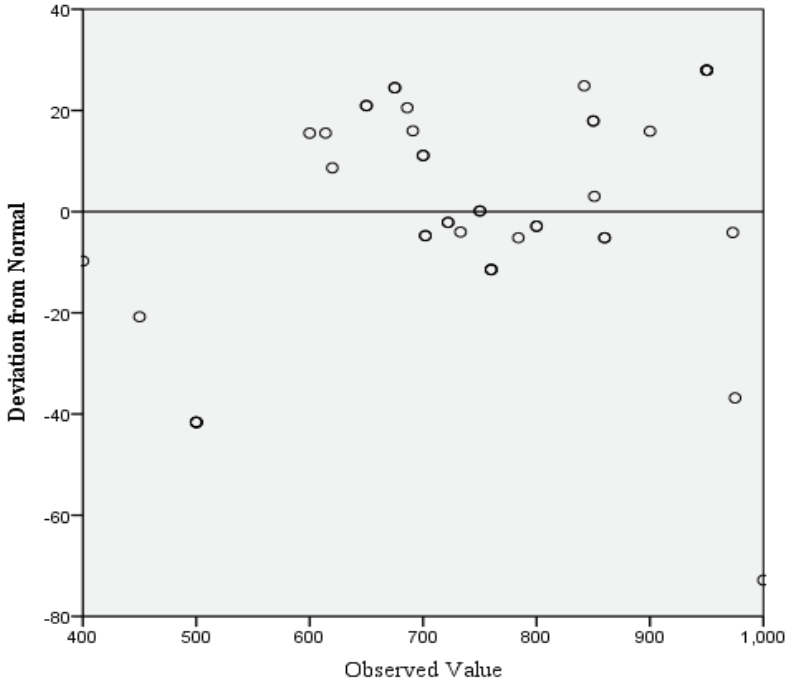


Figure 26. Detrended Normal Q-Q Plot of City Emergency Service Call Residuals.

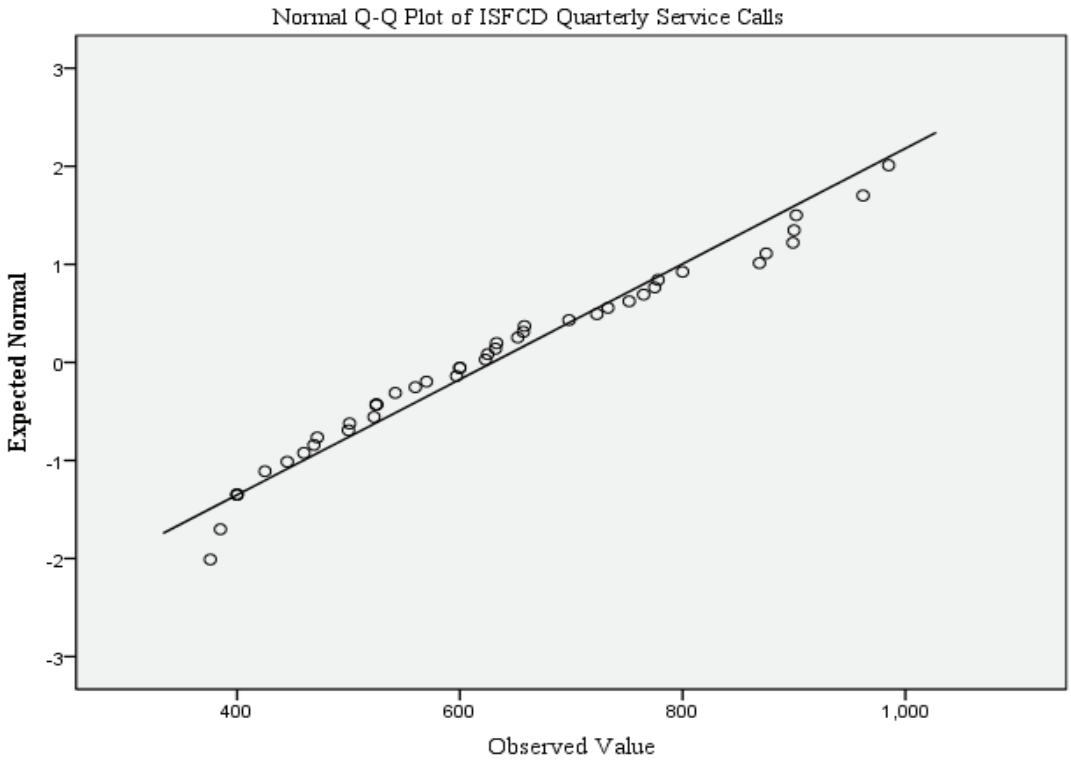


Figure 27. Q-Q Plot of ISFCD Quarterly Emergency Service Calls.

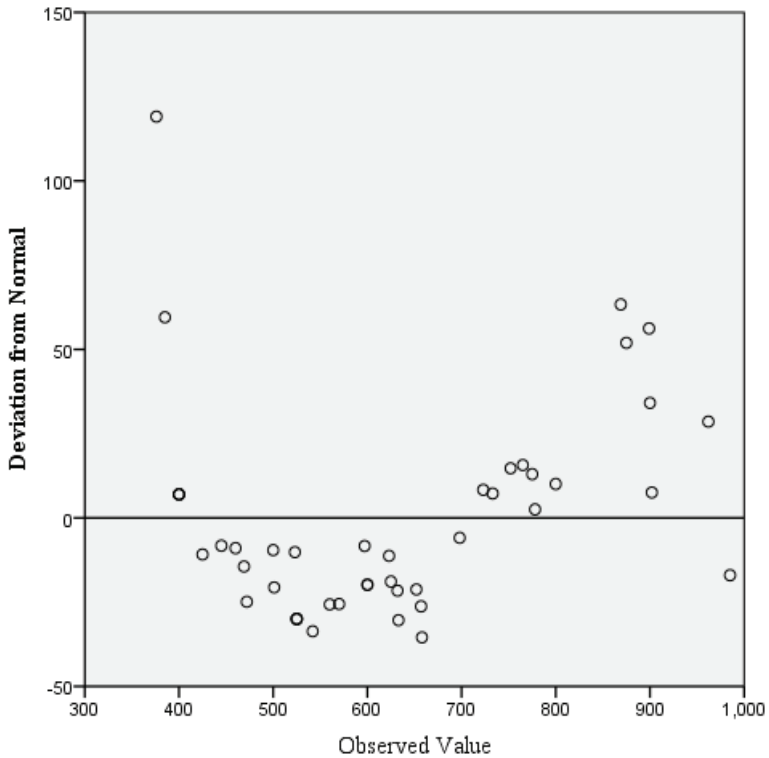


Figure 28. Detrended Normal Q-Q Plot of ISFCD Emergency Service Call Residuals.

With descriptive statistics completed, coupled with appropriate assumption testing for correlation and regression met, the next step entailed building the regression models and analyzing the respective model's residuals. The purpose of the next section was to test for significant statistical correlations among the various organizational designs and the cost of providing a given level of fire service.

Multivariate Regression Modeling

County Multivariate Regression Models

To begin determining statistical significant correlations among the fire department organizational designs, Tables 20, 23, and 25 are multivariable regression model summary statistics for the county fire department, using a 95% confidence interval. Table 20 uses the enter method, where all independent variables are placed into regression building without regard for the R^2 values. The fire station and county square mile variables were removed due to being constant over the 44 data points.

As Table 20 shows, in predicting the county's annual expenditures, population, annual service calls, personnel, cost per square mile, cost per capita, and apparatus were used as the independent variables. Looking at the R^2 value, 99.4% of the observed variability in county annual expenditures is explained by the six remaining independent variables.

Table 20

County Multivariable Regression Model Summary – Enter Selection

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics				
						F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.997[a]	.994	.993	108,373.041	.994	1091.537	6	37	.000	1.919

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, quarterly apparatus, cost per sq. mile, quarterly service calls, quarterly personnel, cost per capita

In Table 20, there is a 99.7% chance that the dependent variable was predicted from the six independent variables. The adjusted R^2 value was 99.3%; this estimate identified how well the current model would fit another dataset from the same population. Lastly, the Durbin Watson statistic checks all observations are independent and in no way related. With a range of 0-4, Norusis (2008b) stated no correlations exist between the successive residuals when the Durbin-Watson value is close to 2. The value for the county regression model was 1.919. Figure 29 confirms the independence assumption was met for all variables in the regression model as all points were not in a defined linear pattern.

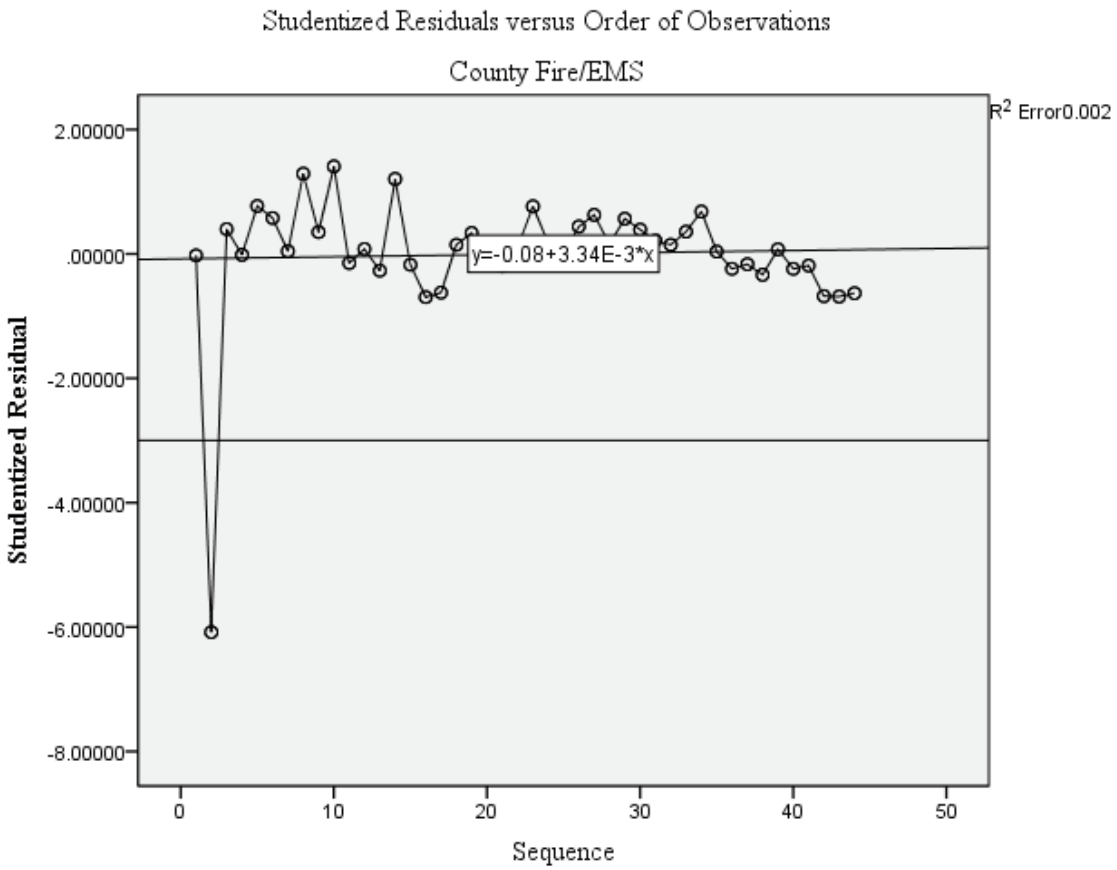


Figure 29. Independence Plot for County Regression Enter Model.

Table 21 shows the results of several equivalency null hypotheses that the population value for multiple R is 0. The null hypotheses are as follows: (a) no linear relationship exists between the dependent and independent variables placed into the model; (b) all population correlation coefficients are 0; and (c) the population value for multiple R^2 is 0. Since the observed significance level is statistically significant, rejecting the null hypothesis that there is no linear relationship between the dependent variable and one of the population regression coefficients is acceptable.

Table 21

ANOVA Summary for Enter Method County Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76918741407587.300	6	12819790234597.883	1091.537	.000[a]
	Residual	434554489672.443	37	11744715937.093		
	Total	77353295897259.730	43			

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, quarterly apparatus, cost per sq. mile, quarterly service calls, quarterly personnel, cost per capita

Table 22 provides the supporting analysis for the previous table, and shows the statistically significant correlations among the dependent variable quarterly expenses and the independent variable service calls, cost per capita, cost per square mile, personnel, and fire stations; thus, rejecting the null hypothesis that there is no linear relationship between the two variables is acceptable. The independent variable population shows an insignificant value of .131, coupled with a 17.3% correlation value to the dependent variable, thus not rejecting the null hypothesis that there is no linear relationship between the two variables is acceptable. As shown in the table, the correlations between quarterly expenses and the independent variables range from .353 for quarterly service calls to .996 for cost per square mile.

Table 22

Correlation Summary for Enter Method County Regression Model

		Quarterly Expenses	Quarterly Service Calls	Cost Per Capita	Cost per sq. mile	Quarterly Personnel	Quarterly Apparatus	Quarterly Population
Pearson Correlation	Quarterly Expenses	1.000	.353	.878	.996	.540	.522	.173
	Quarterly Service Calls	**.353**	1.000	.051	.353	.610	.733	.588
	Cost Per Capita	**.878**	.051	1.000	.880	.405	.396	-.305
	Cost per sq. mile	**.996**	.353	.880	1.000	.519	.500	.176
	Quarterly Personnel	**.540**	.610	.405	.519	1.000	.911	.206
	Quarterly Fire Stations	.	.	.	.	.	.	.
	Quarterly Apparatus	**.522**	.733	.396	.500	.911	1.000	.170
	Quarterly Population	**.173**	.588	-.305	.176	.206	.170	1.000
	Square Miles	.	.	.	.	.	.	.
Sig. (1-tailed)	**Quarterly Expenses**	**.**	**.009**	**.000**	**.000**	**.000**	**.000**	**.131**
	Quarterly Service Calls	.009	.	.370	.009	.000	.000	.000
	Cost Per Capita	.000	.370	.	.000	.003	.004	.022
	Cost per sq. mile	.000	.009	.000	.	.000	.000	.126
	Quarterly Personnel	.000	.000	.003	.000	.	.000	.090
	Quarterly Apparatus	.000	.000	.004	.000	.000	.	.134
	Quarterly Population	.131	.000	.022	.126	.090	.134	.

In determining the best county regression model fit, Tables 23 and 25 were run using the backward and forward selection methods, respectively. Though the regression

model summary statistics present similar values as displayed in Table 20, Table 23, and Table 25, they highlight important county fire organizational design characteristics.

The backward selection method, as described by Norusis (2008b), starts building a model with all the inputted independent variables; then, at each iteration, a variable is removed that causes the least change in multiple r-squared. For Table 23, the parameter to keep a variable IN is set at .05, and to remove is .10. Model 1 in Table 23 displays a R^2 of .994 with all the independent variables added except fire stations and square miles as these terms are constant over the 44 data points. Model 2 in Table 23 displays a R^2 of .994 with population removed. Model 3 in Table 23 displays a R^2 of .994 with personnel removed. Lastly, model 4 in Table 23 displays a R^2 of .994 with cost per capita removed, while fire apparatus, cost per square mile, and quarterly service calls remain. The four models displayed in Table 23 infer that 99.4% of the observed variability in the dependent variable, county quarterly expenditures, is explained by the independent variables in the respective model.

Table 23

County Multivariable Regression Model Summary – Backward Selection

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.997[a]	.994	.993	108,373.041	.994	1091.537	6	37	.000	
2	.997[b]	.994	.994	106,945.727	.000	.006	1	37	.941	
3	.997[c]	.994	.994	105,848.776	.000	.204	1	38	.654	
4	**.997[d]**	**.994**	**.994**	**107,335.423**	**.000**	**2.131**	**1**	**39**	**.152**	**2.003**

Note. a. Predictors: (Constant), quarterly population, quarterly apparatus, cost per square mile, quarterly service calls, quarterly personnel, cost per capita
b. Predictors: (Constant), quarterly apparatus, cost per square mile, quarterly service calls, quarterly personnel, cost per capita
c. Predictors: (Constant), quarterly apparatus, cost per square mile, quarterly service calls, cost per capita
d. Predictors: (Constant), quarterly apparatus, cost per square mile, quarterly service calls

The main differences going through each iteration are the collinearity statistics as displayed in Table 24. As shown in the table, model 4 displays tolerance values closest to 1, which indicate that the independent variable has little of its variability explained by the other independent variables (Norusis, 2008b). Models 1, 2, and 3 in the table display multicollinearity as the values are closer to 0. Lastly, the Durbin-Watson statistic shows a value of 2.003, which indicates that the test for correlation of adjacent residuals is normal; thus, the residuals are not correlated with each other.

Table 24

Tolerance and Multicollinearity Values – County Fire/EMS Backward Selection

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Quarterly Service Calls	.198	5.054
	Cost Per Capita	.006	171.724
	Cost per square mile	.006	160.784
	Quarterly Personnel	.133	7.519
	Quarterly Apparatus	.082	12.151
	Quarterly Population	.025	39.820
2	(Constant)		
	Quarterly Service Calls	.199	5.023
	Cost Per Capita	.099	10.063
	Cost per square mile	.100	9.952
	Quarterly Personnel	.141	7.090
	Quarterly Apparatus	.086	11.586
3	(Constant)		
	Quarterly Service Calls	.230	4.345
	Cost Per Capita	.111	9.049
	Cost per square mile	.115	8.685
	Quarterly Apparatus	.297	3.366
4	(Constant)		
	Quarterly Service Calls	.463	2.161
	Cost per square mile	.750	1.334
	Quarterly Apparatus	.397	2.521

The forward selection method, as described by Norusis (2008b), starts building a model with only a constant term and, at each step, a variable is added that results in the largest r-squared multiple increase. For Table 25, the parameter to keep a variable IN is

set at .050. Model 1 in Table 25 displays a R^2 of .993 and the variable added is cost per square mile. Model 2 in Table 25 displays a R^2 of .993 and the variable, apparatus, is added to the model.

Models 1 and 2 in the table infer that 99.3% of the observed variability in the dependent variable, county quarterly expenditures, is explained by the independent variables cost per square mile and fire apparatus. As shown in Table 23, the Durbin-Watson statistic in Table 25 is 2.076; thus, the adjacent residuals are normal and not correlated with each other.

Table 25

County Multivariable Regression Model Summary – Forward Selection

						Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.996[a]	.993	.993	116,107.871	.993	5695.933	1	42	.000	
2	.997[b]	.993	.993	111,246.030	.001	4.751	1	41	.035	2.076

Note. a. Predictors: (Constant), cost per square mile
b. Predictors: (Constant), cost per square mile, quarterly apparatus

Lastly, Table 26 model 2 shows that the tolerance levels are close to 1 at .750; thus the independent variables, cost per square mile and apparatus, do not have their variability explained by each other.

Table 26

Tolerance and Multicollinearity Values – County Fire/EMS Forward Selection

		Collinearity Statistics	
	Model	Tolerance	VIF
1	(Constant)		
	Cost per square mile	1.000	1.000
2	(Constant)		
	Cost per square mile	.750	1.333
	Quarterly Apparatus	.750	1.333

Based on the regression models presented in Tables 20, 23, and 25, the county fire/EMS model selected for this research is the backward entry selection method as shown in Table 23, specifically, model 4. The reason for selecting this method and model, is due to the model's summary data, as shown in Table 23, and little multicollinearity present within the independent variables, as shown in Table 24.

Figure 30 shows an approximate normal distribution of the regression residuals from the results displayed in Table 23, and Figure 31 is a linearity check for the predicted values of the dependent variable, quarterly expenditures, against the independent variables residuals. The band of residuals distributed randomly around the line infers linearity is met.

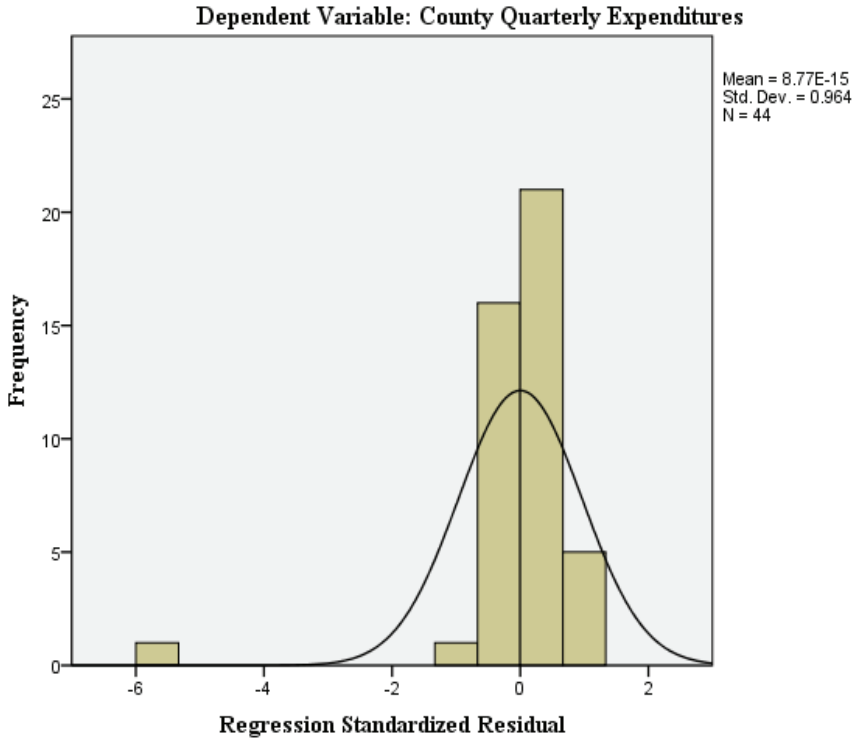


Figure 30. County Fire/EMS Histogram of Backward Selection Residuals.

The leverage statistic, according to Norusis (2008b), identifies cases of unusual independent variable values. The statistic measures how far the values of a case are from the means of all independent variables (2008b). As depicted in Figure 32 by labels 1-44, there are no values close to 1. Hence, the model's independent variables possess no unusual values across their means.

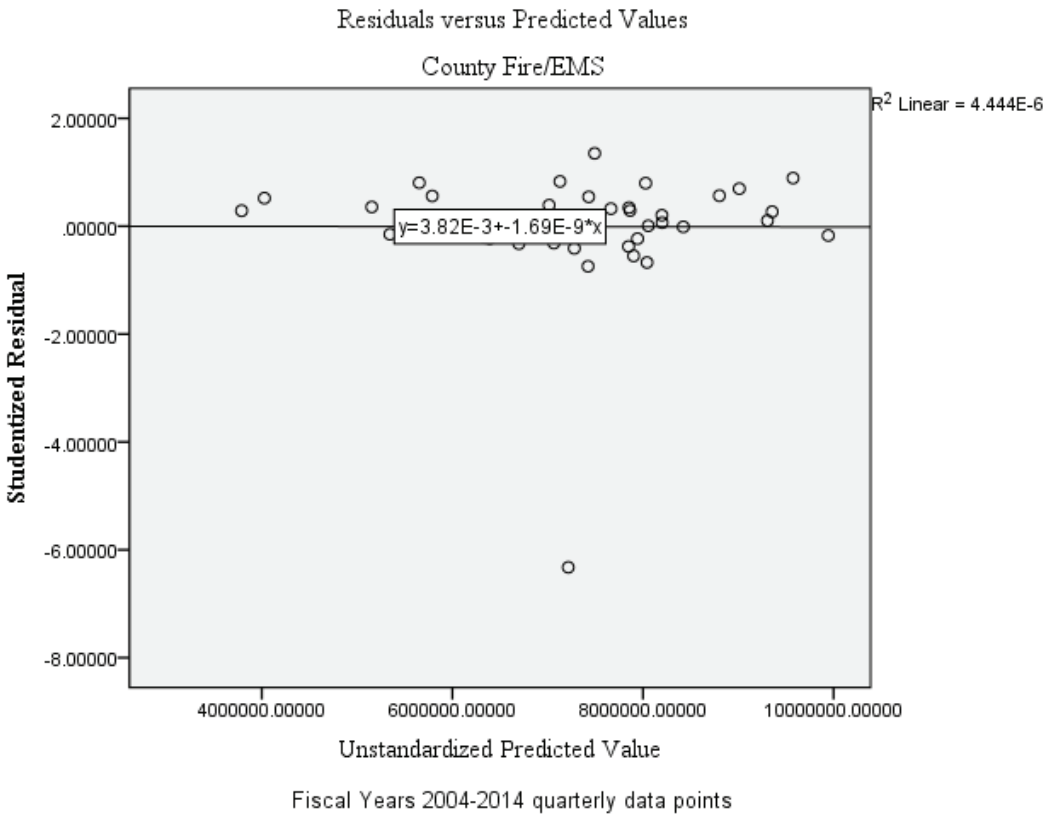


Figure 31. Scatterplot of Studentized Residuals versus the Predicted Values of County Fire/EMS Quarterly Expenditures – Backward Selection.

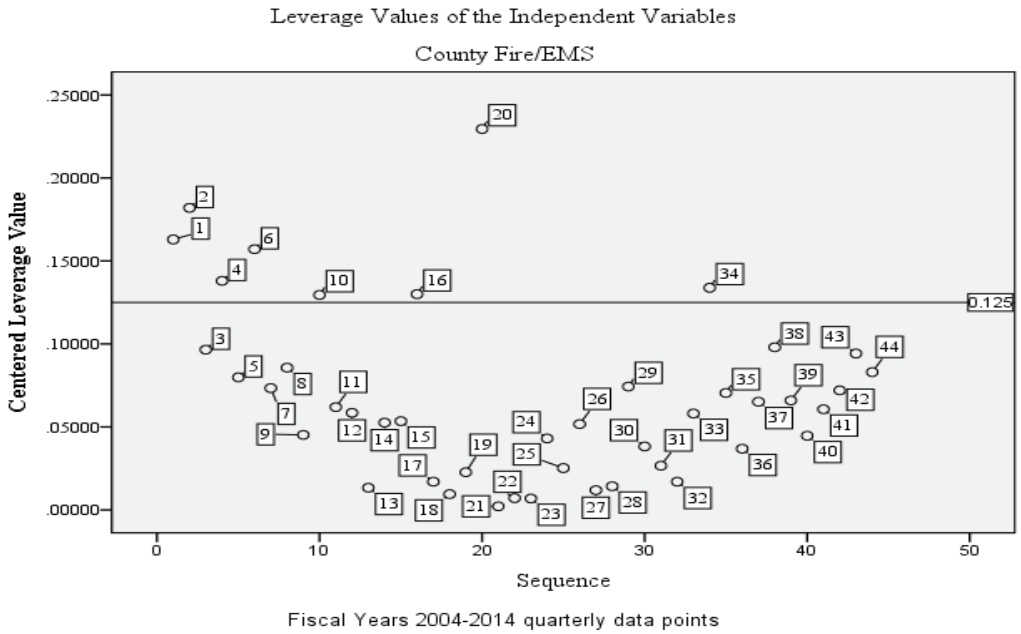


Figure 32. County Fire/EMS Leverage for Points in the Backward Selection Regression.

Figures 33 and 34 show the regression model for predicting annual expenditures comes from a normal distribution. Figure 33 shows the assumption of equal variances is met as the distribution moves in a linear fashion for the observed county quarterly expense values. The label points in Figure 33 represent the sample size (1 = FY 2004 quarter 1 and 44 = FY 2014 quarter 4). Figure 34 shows the P-P plot of residuals falling close to or on the straight line labeled by fiscal year quarter. Table 27 shows the normality results of the statistical tests. According to the statistically significant observed levels in Table 27, there is enough evidence to reject the assumption of normality. However, Norusis (2008b) stated, "…even small deviations from normality that won't affect your analysis may cause you to reject the null hypothesis that the samples come from normal populations. Make your decisions based on the diagnostic plots" (p. 150). Therefore, based on the above, the null hypothesis is accepted that the sample comes from normally distributed populations.

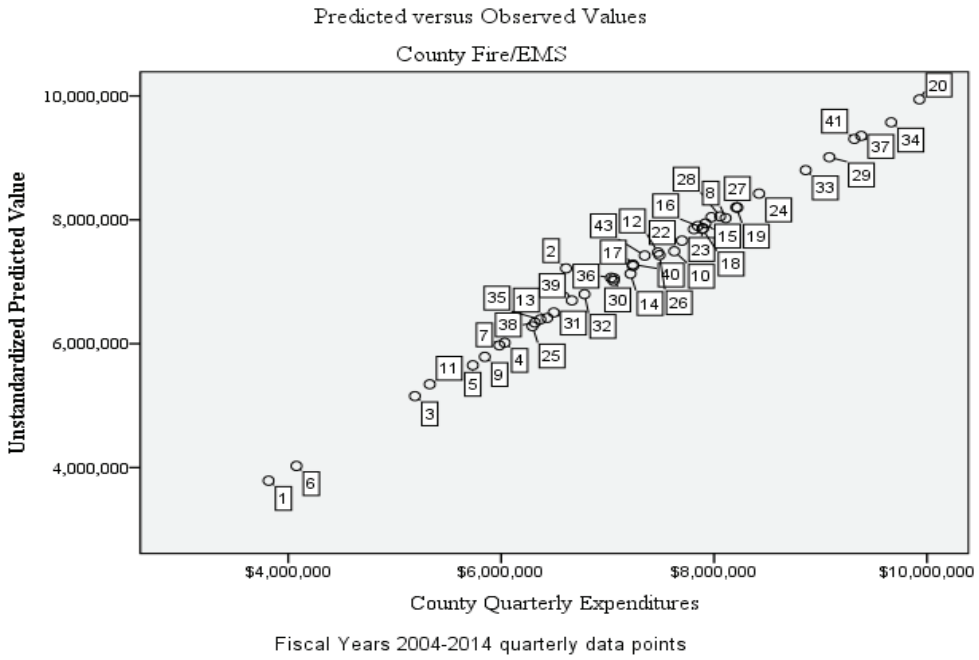


Figure 33. Scatterplot of County Fire Predicted and Observed Values – Backward Selection.

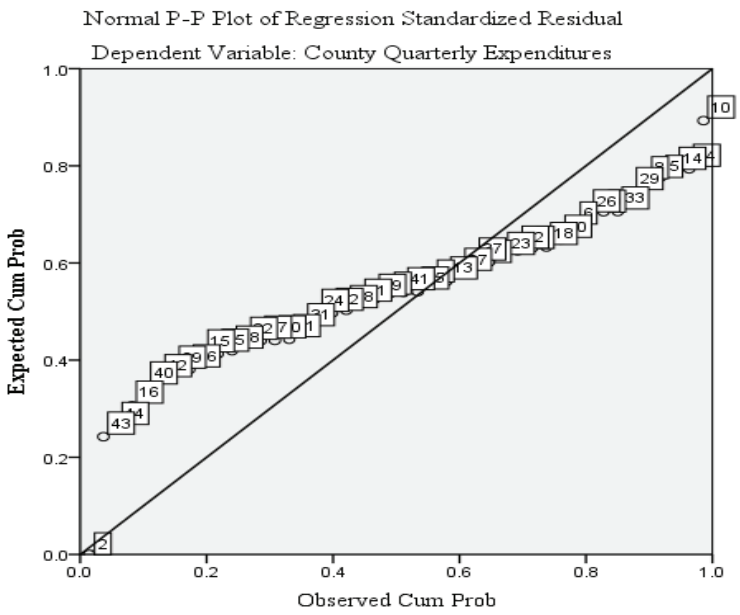


Figure 34. P-P Plot of County Fire Residuals – Backward Selection.

Table 27

Normality Test of Residuals County Fire/EMS – Backward Selection

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.249	44	.000	.538	44	.000

Note. a. Lilliefors Significance Correction

Figure 35 is another tool for showing linearity and identifying influential observations for the model's variables. This figure is a partial regression plot for the independent variable, county cost per square miles. The linear relationship shows that cost per square mile is linearly related to quarterly expenses. Lastly, Figure 36 shows the plot of residuals against the independent variable cost per square miles. The lack of pattern denotes an acceptable regression model.

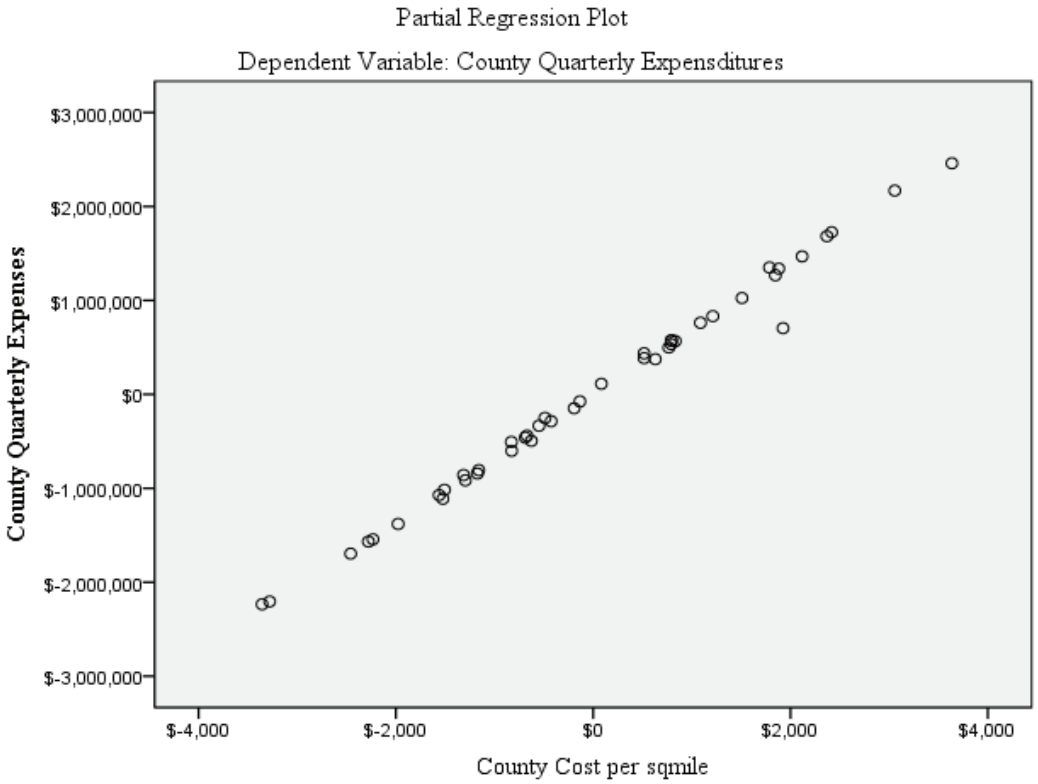


Figure 35. Partial Regression Plot County Fire/EMS – Backward Selection.

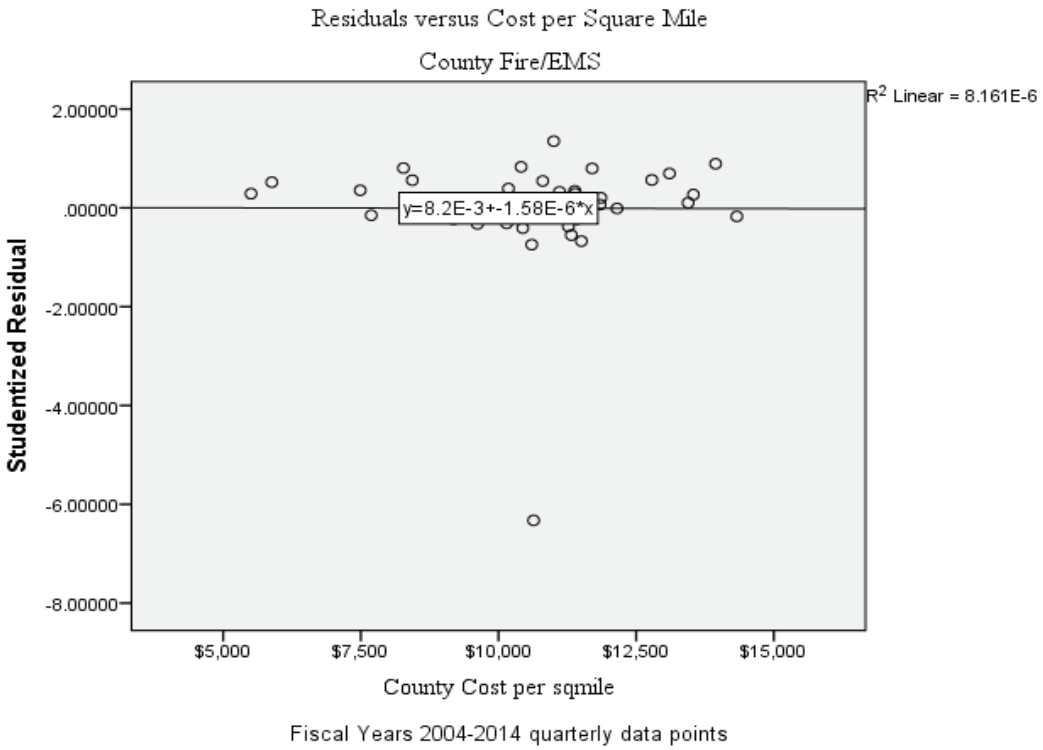


Figure 36. Residual Plot versus County/EMS Fire Cost per square Mile – Backward Selection.

Using a 95% confidence interval, Table 28 model 4 displays the slopes and intercept of the multivariate regression predicting the dependent variable county average quarterly expenditures. The regression equation is shown as follows:

Equation 2. Regression Equation for County Fire/EMS Average Quarterly Expenditures

*Average Quarterly Expenditures = (14,634.999) – (67.708 * Quarterly Service Calls) + (680.814 * Cost per square mile) + (13,534.766 * Quarterly Apparatus).*

Table 28

County Fire/EMS Regression Coefficients – Backward Selection

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	437593.808	1155648.793		.379	.707
	Quarterly Service Calls	-124.638	51.998	-.066	-2.397	.022
	Cost Per Capita	-10459.421	24074.245	-.070	-.434	.666
	Cost per sq. mile	726.111	108.565	1.045	6.688	.000
	Quarterly Personnel	-1244.253	2998.831	-.014	-.415	.681
	Quarterly Apparatus	20745.929	9924.883	.090	2.090	.044
	Quarterly Population	-.565	7.516	-.006	-.075	.941
2	(Constant)	356557.609	408980.812		.872	.389
	Quarterly Service Calls	-124.940	51.159	-.067	-2.442	.019
	Cost Per Capita	-8704.785	5750.876	-.058	-1.514	.138
	Cost per sq. mile	718.212	26.654	1.034	26.946	.000
	Quarterly Personnel	-1298.075	2873.627	-.015	-.452	.654
	Quarterly Apparatus	20906.644	9563.895	.090	2.186	.035
3	(Constant)	193178.701	188964.674		1.022	.313
	Quarterly Service Calls	-116.446	47.090	-.062	-2.473	.018
	Cost Per Capita	**-7880.168**	5397.513	-.053	-1.460	.152
	Cost per sq. mile	713.916	24.644	1.027	28.969	.000
	Quarterly Apparatus	17267.786	5102.318	.075	3.384	.002
4	(Constant)	**14634.999**	**146078.772**		**.100**	**.921**
	Quarterly Service Calls	**-67.708**	**33.678**	**-.036**	**-2.010**	**.051**
	Cost per sq. mile	**680.814**	**9.793**	**.980**	**69.522**	**.000**
	Quarterly Apparatus	**13534.766**	**4477.416**	**.059**	**3.023**	**.004**

Note. Dependent Population Variable: quarterly expenditures

The negative coefficients for quarterly service calls means that the predicted value of average quarterly expenditures decrease when quarterly service calls increase. The positive coefficient attributed with cost per square mile means that as this value increases

so does the predicted fire department quarterly expenditures. The coefficient for cost per square mile denotes that for a change of 1 in the value of cost per square mile, the predicted average quarterly expenditures increase by $681. The positive fire apparatus coefficient means that for a change of 1 in the value of fire apparatus, the predicted average quarterly expenditures increase by $13,538. The coefficient for quarterly service calls denotes that for a change of 1 in the value of quarterly service call, the predicted average quarterly expenditures decrease by $68. Based on the results of Table 28 and Equation 2, we may infer that the county fire organizational design achieves economies of scale as quarterly service calls increase. Moreover, it can be inferred that the consolidated county fire/EMS agency's cost drivers are not quarterly service calls; rather, it is apparatus and cost to protect a given unit of square mile.

The average total fixed and variable costs of producing a given level of service (i.e., quantity) in the county fire/EMS centralized organizational design decreases as output (i.e., calls for service) increases. Second, it can be inferred that costs associated with a jurisdiction's square miles varies directly with the predicted average quarterly expenditures. Lastly, when the county fire department adds an apparatus to the fleet, it can be inferred that the average predicted quarterly costs increase.

City Multivariate Regression Models

To begin determining statistical significant correlations among the city fire department organizational design, Tables 29, 30, and 31 are multivariable regression model summary statistics using a 95% confidence interval. Using the entry method as shown in Table 29, the eight independent variables are placed into regression building without regard for the R^2 values. The fire station, square mile, personnel and apparatus

variables were removed due to being constant over the 44 quarterly data points. As shown in the table, the remaining independent variables explain 94.9% of the variability in the dependent variable, city quarterly expenditures, with a Durbin-Watson statistic of 1.469.

Table 29

City Multivariable Regression Model Summary – Enter Selection

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.974[a]	.949	.943	27,773.202	.949	180.265	4	39	.000	1.469

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, cost per capita, quarterly service calls, cost per square mile

Using Table 30 model 3 to predict the city's average quarterly expenditures, quarterly population and cost per capita are used as the independent variables as quarterly service calls and cost per square mile were removed based on the probability of F-to-remove is set at > = .100. Looking at the R^2 value, 94.7% of the observed variability in city quarterly average expenditures is explained by the two remaining independent variables.

Table 30

City Multivariable Regression Model Summary – Backward Selection

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.974[a]	.949	.943	27,773.202	.949	180.265	4	39	.000	
2	.974[b]	.949	.945	27,459.290	.000	.101	1	39	.752	
3	.973[c]	.947	.944	27,574.247	-.002	1.344	1	40	.253	1.377

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, cost per capita, quarterly service calls, cost per square mile
b. Predictors: (Constant), quarterly population, cost per capita, cost per square mile
c. Predictors: (Constant), quarterly population, cost per capita

The R value in Table 31 indicates that there is a 97.3% chance that the dependent variable can be predicted from the two independent variables cost per capita and quarterly population. These variables entered the model at a forward criterion of < = .050. The adjusted R^2 value of 94.4% shows how well the current model would fit another dataset from the same population. Lastly, with a 1.377 Durbin Watson statistic it may be inferred that no correlations exist between the successive residuals.

Table 31

City Multivariable Regression Model Summary – Forward Selection

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.936[a]	.877	.874	41,503.346	.877	298.357	1	42	.000	
2	**.973[b]**	**.947**	**.944**	**27,574.247**	**.070**	**54.150**	**1**	**41**	**.000**	**1.377**

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), cost per capita
b. Predictors: (Constant), cost per capita, quarterly population

The city's fire model selected for this research is the forward entry selection method as shown in Table 31 model 2. The backward and forward entry models are shown in Tables 30 and 31 with model summary statistics. There is a preference for entering the variable that causes the largest increase in multiple R^2 into the model first. In this case, cost per capita causes the largest increase in multiple R^2, followed by quarterly population at 7% (.947 -.877).

As shown in Figure 37, the independence assumption is met for all variables in the regression model due to non-defined linear pattern point distributions. The fit line with its respective legend shows some linear movement within the model's independent variables from their mean values.

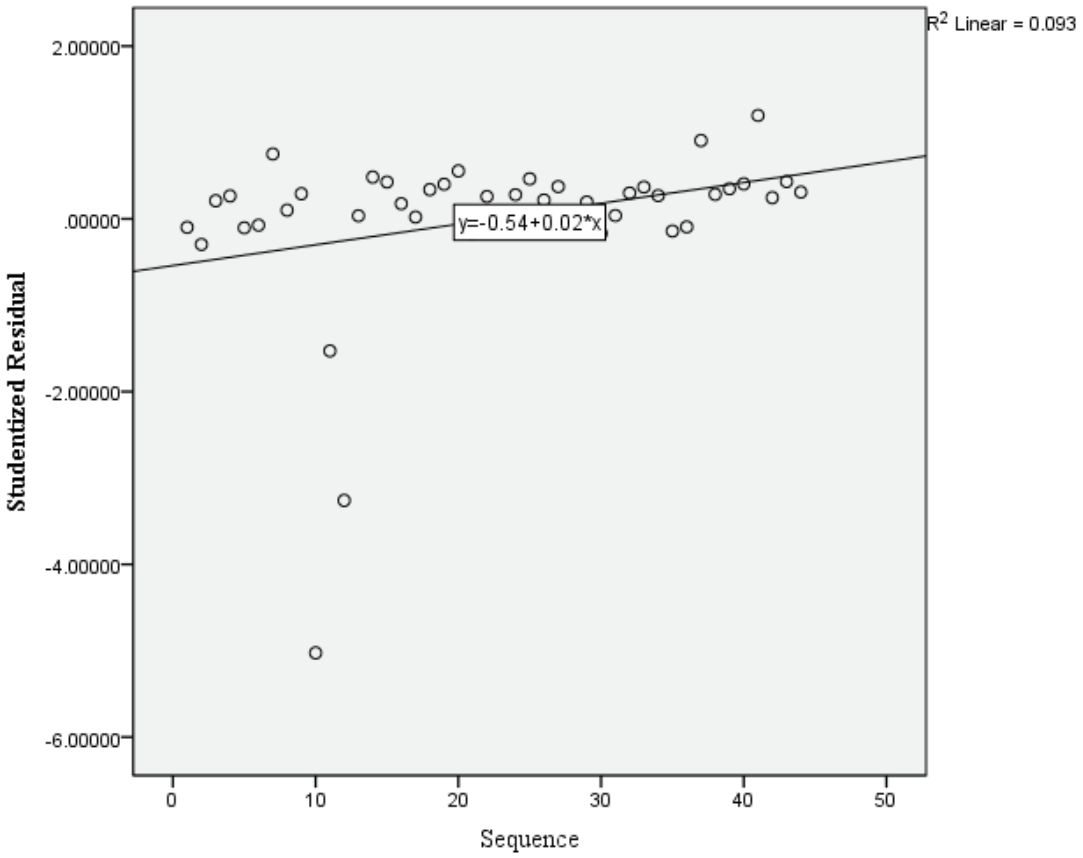


Figure 37. Independence Plot for City Regression Forward Model.

Table 32 shows the results of several equivalency null hypotheses. These hypotheses are (a) no linear relationship exists between the dependent and independent variables placed into the model, (b) all population correlation coefficients are 0 and (c) the population value for multiple R^2 is 0 (Norusis, 2008b). The observed regression significance of .000 is less than .05; thus rejecting the null hypotheses that the independent variables are not linearly related to the dependent variable is appropriate. As such, linear relationships exist between the dependent and independent variables for the regression model used.

Table 32

ANOVA Summary for Forward Method City Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	513927753998.470	1	513927753998.470	298.357	.000[a]
	Residual	72346166324.076	42	1722527769.621		
	Total	586273920322.545	43			
2	Regression	555100016672.810	2	277550008336.405	365.035	.000[c]
	Residual	31173903649.735	41	760339113.408		
	Total	586273920322.545	43			

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), cost per capita
b. Predictors: (Constant), cost per capita, quarterly population

Table 33 provides the supporting analysis for Table 32 and shows positive correlations among the dependent variable, average quarterly expenses, and the independent variables, service calls, cost per capita, cost per square mile, and population. The variables used in this model from Table 31, cost per capita and population, show positive correlation coefficients 0.936 and .190, respectively.

Table 33

Correlation Summary for Forward Method City Regression Model

		Quarterly Expenses	Quarterly Service Calls	Cost Per Capita	Cost per sq. mile	Quarterly Population
Pearson Correlation	Quarterly Expenses	1.000	.254	.936	.669	.190
	Quarterly Service Calls	**.254**	1.000	.171	.121	.317
	Cost Per Capita	**.936**	.171	1.000	.602	-.079
	Cost per sq. mile	**.669**	.121	.602	1.000	.233
	Quarterly Population	**.190**	.317	-.079	.233	1.000
Sig. (1-tailed)	**Quarterly Expenses**	.	.048	.000	.000	.108
	Quarterly Service Calls	**.048**	.	.134	.217	.018
	Cost Per Capita	**.000**	.134	.	.000	.305
	Cost per sq. mile	**.000**	.217	.000	.	.064
	Quarterly Population	**.108**	.018	.305	.064	.
N	Quarterly Expenses	44	44	44	44	44
	Quarterly Service Calls	44	44	44	44	44
	Cost Per Capita	44	44	44	44	44
	Cost per sq. mile	44	44	44	44	44
	Quarterly Population	44	44	44	44	44

Prior to examining the models' independent variable coefficients and writing the estimated regression equation for the predicted change in quarterly expenditures, the following attributes were analyzed: (a) tolerance and multicollinearity, (b) normality, (c) leverage, and (d) constant variance.

The tolerance values as shown in Table 34 are greater than 0.1, indicating the models' independent variables have little of its variability explained by the other independent variables. Moreover, Table 34 model 2 shows 0.954 for the part correlation cost per capita coefficient, which means this variable provides unique information about the dependent variable average quarterly expenditures that is not available from the other independent variables in the model.

Table 34

Tolerance and Multicollinearity Values for the City Fire Department – Forward Method

		Correlations			Collinearity Statistics	
Model		Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)					
	Cost per capita	.936	.936	.936	1.000	1.000
2	(Constant)					
	Cost per capita	.936	.972	.954	**.994**	**1.006**
	Quarterly population	.190	.754	.265	**.994**	**1.006**

Note. Dependent Variable: quarterly expenses

Figures 38 and 39 show that the regression model for predicting quarterly city fire expenditures comes from a normal distribution. Figure 38 shows the residuals falling close to or on the straight line, and Figure 39 shows the assumption of equal variances is met as the distribution moves in a linear fashion for the observed city quarterly

expenditure values. The labeled points represent the sample size (e.g., 1 = FY 2004 quarter 1, and 44 = FY 2014 quarter 4; the quarters are successively numbered 1-44).

The leverage statistic, according to Norusis (2008b), identifies cases of unusual independent variable values. The statistic measures how far the values of a case are from the means of all independent variables. As depicted in Figure 40, there are no values close to 1 as shown on the Y-axis; thus the models' independent variables possess no unusual values across their means.

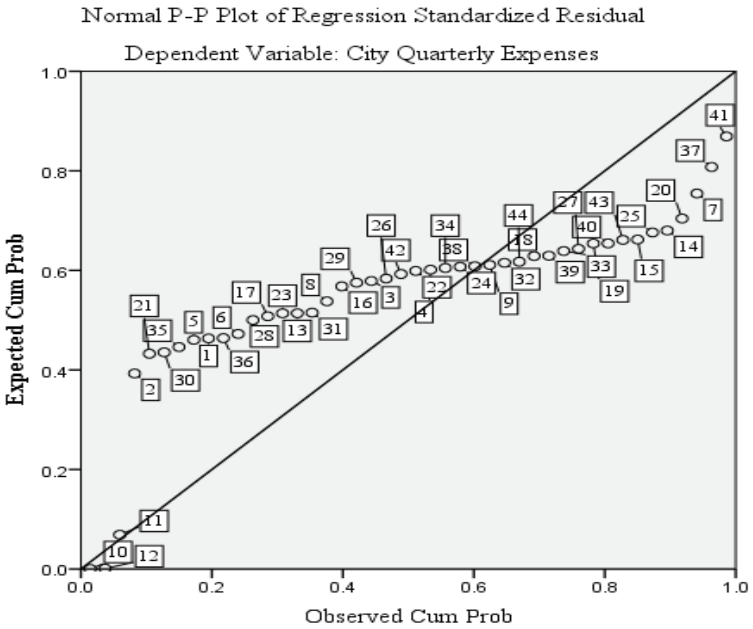


Figure 38. P-P Plot of City Fire Residuals.

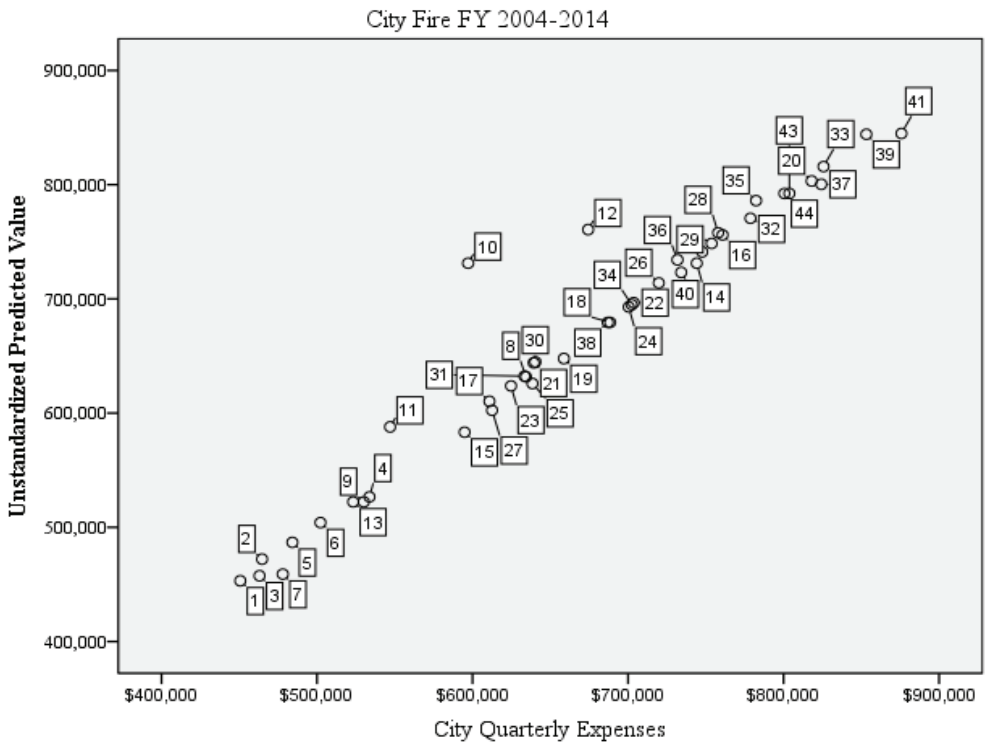


Figure 39. City_Fire Quarterly Expenditures Predicted and Observed Values.

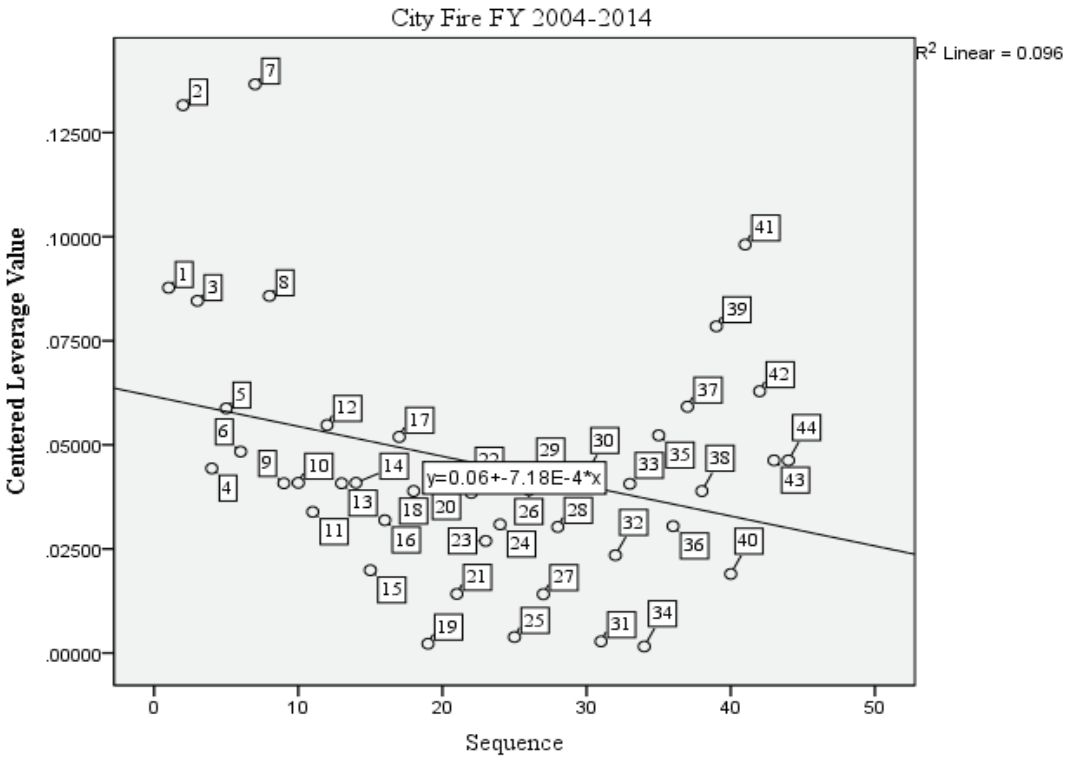


Figure 40. City Fire Leverage Points for the Independent Variables.

The last assumption test is shown in Figure 41, which is displaying that the constant variance for the dependent variable is the same for all the independent variable values used in the model as there is a randomly displaced pattern of data points around a horizontal line through 0 (with the exception of points 10 and 12). If the constant variance assumption is violated, as Norusis (2008a) stated, there would be a distinct pattern in the data points.

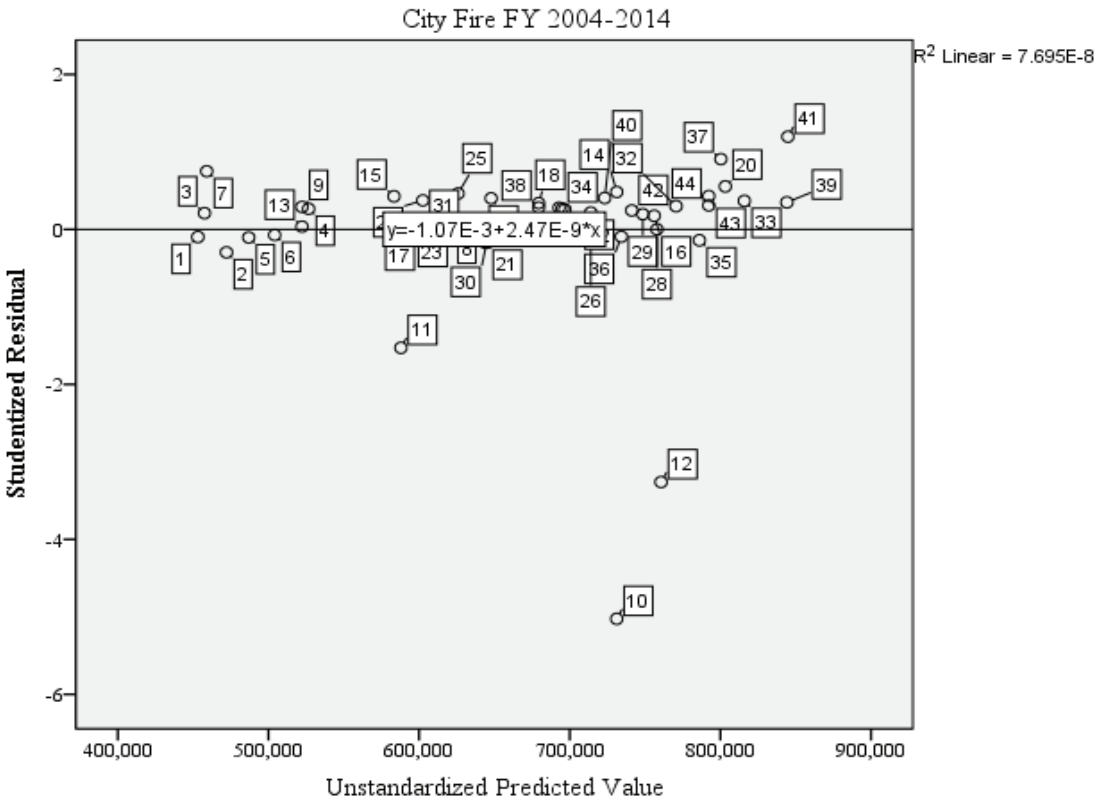


Figure 41. Scatterplot of Studentized Residuals versus Unstandardized City Fire Annual Expenditure Predicted Values.

Using a 95% confidence interval, Table 35 model 2 displays the slopes and intercept for the multivariate regression model, and predicting the dependent variable, city quarterly expenditures, is shown in Equation 3.

Table 35

City Fire Regression Coefficients Forward Selection Model

		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	Model	B	Std. Error	Beta	*t*	Sig.	Tolerance	VIF
1	(Constant)	31923.261	37271.632		.857	.397		
	Cost per capita	16893.469	978.027	.936	17.273	.000	1.000	1.000
2	(Constant)	-630972.699	93425.286		-6.754	.000		
	Cost per capita	17272.797	651.829	.957	26.499	.000	.994	1.006
	Quarterly population	36.240	4.925	.266	7.359	.000	.994	1.006

Equation 3. Regression Equation for City Fire Average Quarterly Expenditures

*Average Quarterly Expenditures = - (630,972.699) + (17,272.797 * Cost per Capita) + (36.240 * Population).*

The positive coefficients attributed with cost per capita and quarterly population means that as these values increase so do the predicted quarterly expenditures. The coefficient for quarterly population denotes that one additional member of the population causes annual expenditures to increase by $36.24.

As shown in Table 35, the independent variables, cost per capita and quarterly population, are statistically significant at the .05 level. The null hypothesis that the slope (i.e., variable coefficients) is 0 is rejected and this infers that a liner relationship exists between average quarterly expenditures and population and cost per capita. From this model, it may be inferred that the city fire department does not achieve economies of scale based on quarterly service calls.

ISFCD Multivariate Regression Models

To begin determining statistical significant correlations among the ISFCD organizational design, various multiple regression summary models using different combination of independent variables against the dependent variable, average quarterly expenditures were composed and analyzed. As shown in Table 36, in predicting average quarterly expenditures, the independent variables, personnel, service calls, apparatus, population, and fire stations, are used (cost per capita and cost per square mile were purposefully left out of the regression models). Looking at the R^2 value, 64% of the observed variability in average quarterly expenditures is explained by the independent variables. The sixth independent variable, square miles, is removed from all models due to remaining constant over the 44 data points.

Table 36

ISFCD Multivariable Regression Model Summary – Enter Selection

						Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.801[a]	.642	.595	$376,234.954	.642	13.632	5	38	.000	1.879

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly personnel, quarterly population, quarterly apparatus, quarterly service calls, quarterly fire stations

Table 37 displays a forward selection model that enters the independent variable, population, because it is the variable that causes the largest increase in R^2. As shown in the table, population accounts for 48% of the observed variability in quarterly expenditures. As shown in Figures 42 and 43, respectively, the partial regression plot displays an assumption of equal variances is met, and the histogram is a symmetrical

distribution with a single peak. However, the forward entry model is not sufficient as only one independent variable, population, enters the model.

Table 37

ISFCD Multivariable Regression Model Summary – Forward Selection

						Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.690[a]	.476	.463	$433,128.563	.476	38.104	1	42	.000	1.646

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population

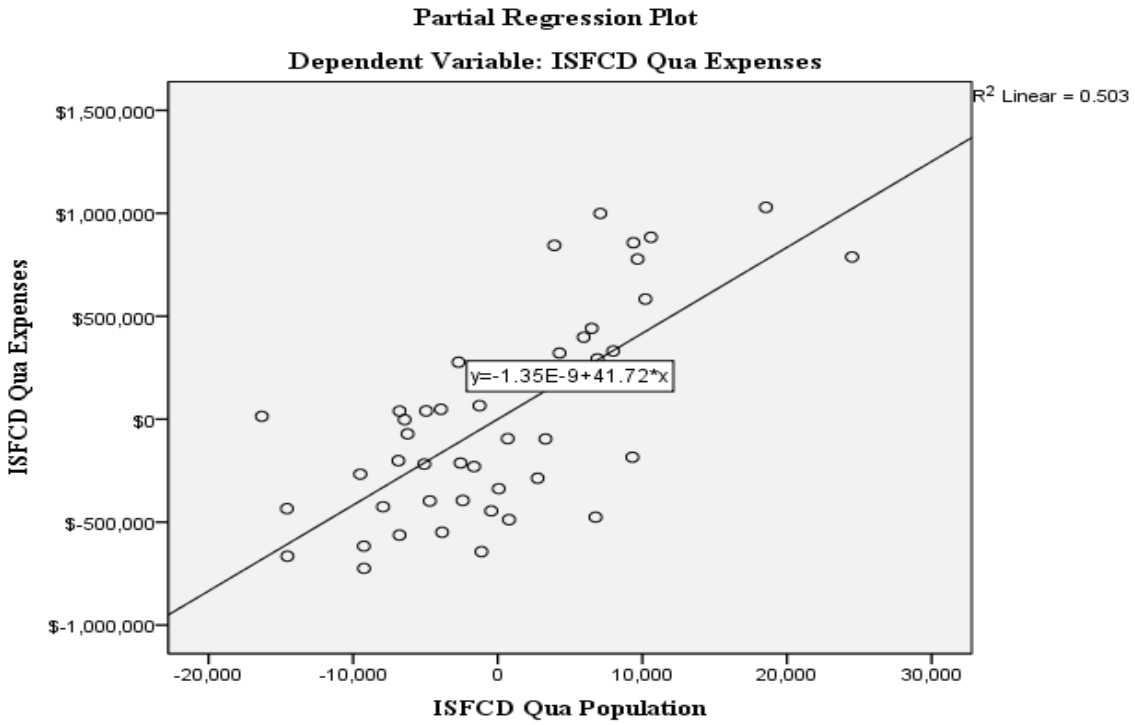


Figure 42. ISFCD Partial Regression Plot of Quarterly Population – Forward Selection.

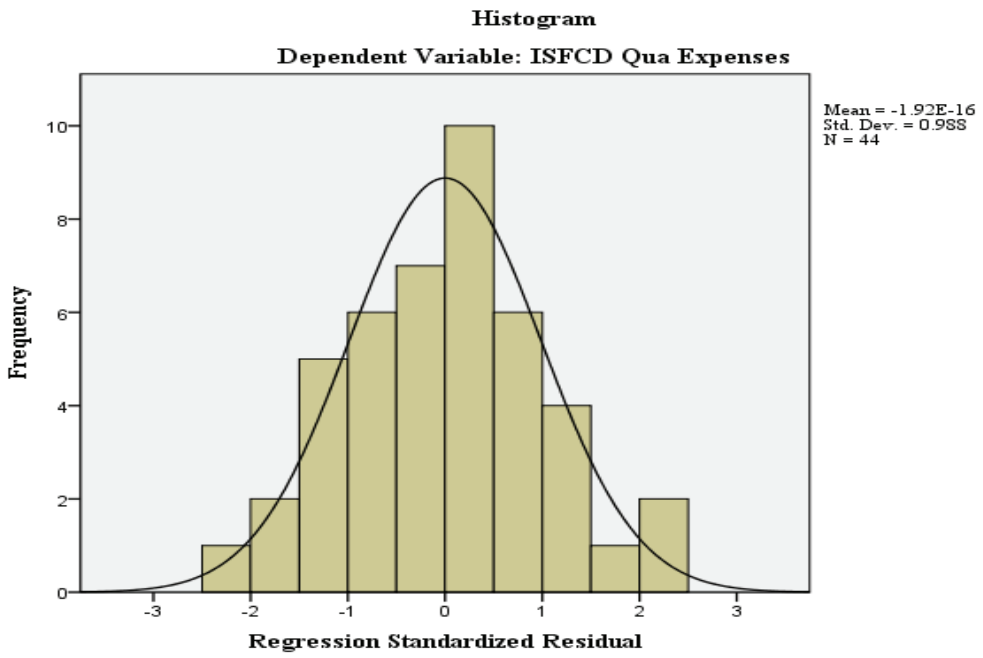


Figure 43. ISFCD Histogram of Residuals – Forward Selection.

Table 38 uses the enter method with the independent variables, service calls and population. Looking at the R^2 value, 49% of the observed variability in quarterly expenditures is explained by service calls and population. The regression assumptions used in developing this model are satisfied, as shown in Figures 44 and 45. The results reported in Figure 44 displays a normally distributed and symmetric pattern, and the partial regression plot, as shown in Figure 45, displays a negative linear relationship of the dependent and independent variable residuals. The negative linear relationship between the dependent variable, quarterly expenditures, and the independent variable, quarterly service calls, shows that as emergency service calls increase, quarterly costs decrease.

Table 38

ISFCD Multivariable Regression Model Summary – Enter Selection

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					
					R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.697[a]	.486	.461	$433,834.735	.486	19.422	2	41	.000	1.433

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, quarterly service calls

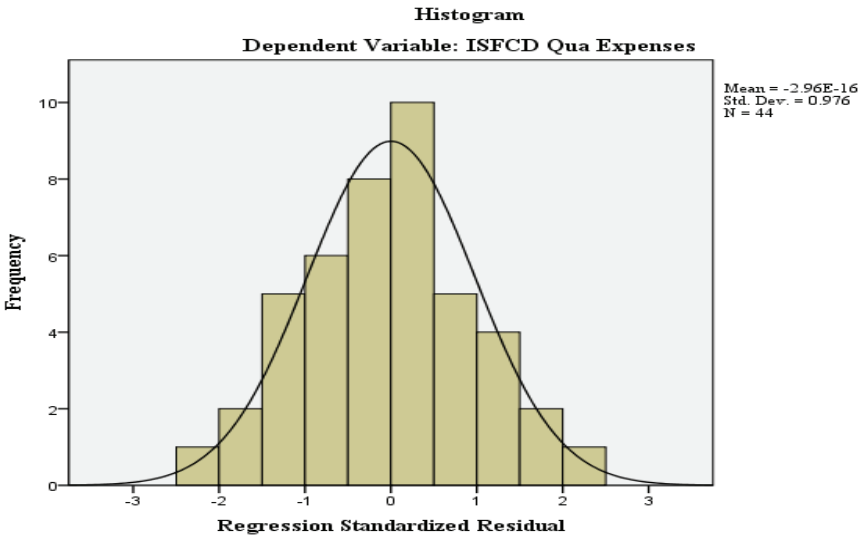


Figure 44. ISFCD Histogram of Residuals – Enter Method.

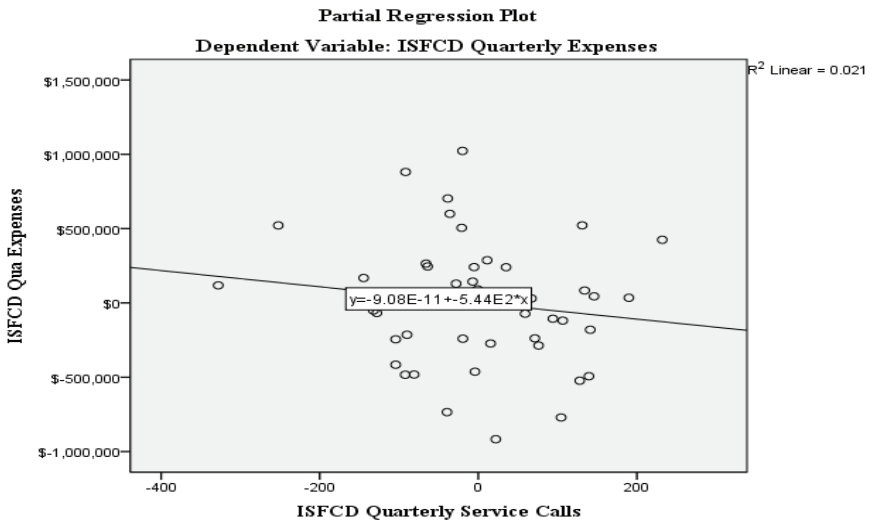


Figure 45. ISFCD Partial Regression Plot of Expenses vs. Service Calls – Enter Method.

Table 39 displays a backward elimination regression model that shows that, during each iteration, the variable changing R^2 the least is removed from the model. Table 39 model 1 includes the same five independent variables as used in Table 36. In Table 39 model 2, the fire apparatus variable is removed, and there is a less than 1% change in R^2. The remaining independent variables, personnel, service calls, fire stations, and population, explain 64% of the observed variability in quarterly expenditures.

The correlation coefficient of 0.80 in Table 39 model 2 indicates the linear regression model predicts well the correlation coefficient between the observed value of quarterly expenditures and its predicted value. The reported Durbin-Watson statistic of 1.83 infers no correlation of the independent variables' adjacent residuals. The descriptive statistics for the ISFCD are presented in Table 40.

Table 39

ISFCD Multivariable Regression Model Summary – Backward Method

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.801[a]	.642	.595	$376,234.954	.642	13.632	5	38	.000	
2	**.799[b]**	**.638**	**.601**	**$373,531.679**	**-.004**	**.442**	**1**	**38**	**.510**	**1.833**

Note. Dependent Variable: quarterly expenses.
a. Predictors: (Constant), quarterly population, quarterly fire stations, quarterly personnel, quarterly service calls, quarterly apparatus
b. Predictors: (Constant), quarterly population, quarterly fire stations, quarterly personnel, quarterly service calls

Table 40

ISFCD Descriptive Statistics

Unit	*M*	*SD*	*N*
Quarterly Expenses	$1,543,749.41	**$591,165.273**	44
Quarterly Service Calls	629.45	169.816	44
Square Miles	83.00	.000	44
Quarterly Apparatus	5.20	1.286	44
Quarterly Personnel	58.73	3.675	44
Quarterly Fire Stations	4.91	.960	44
Quarterly Population	65,090.91	13,257.412	44

As shown in Table 41 model 2, the independent variable, quarterly service calls, is statistically insignificant ($p > .05$), hence, one cannot reject the null hypothesis that the slope for quarterly service calls is 0. There is a statistically significant correlation for the remaining three independent variables as depicted by $p < .05$, thus we are able to reject the null hypothesis that the slope is 0 and infer a liner relationship exists between the dependent variable, quarterly expenditures.

Based on the results as shown in Table 41 model 2, it can be inferred that the ISFCD does achieve economies of scale, as a negative linear relationship exists between the predicted dependent variable, quarterly expenditure, and the independent variable, quarterly service calls.

Table 41

ISFCD Regression Coefficients – Backward Method

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	*t*	Sig.	Lower Bound	Upper Bound
1	(Constant)	-6158607.802	1639928.183		-3.755	.001	-9478468.845	-2838746.759
	Quarterly Service Calls	-1140.934	558.189	-.328	-2.044	.048	-2270.929	-10.939
	Quarterly Apparatus	107703.788	162079.240	.234	.665	.510	-220408.479	435816.056
	Quarterly Personnel	69983.745	21909.230	.435	3.194	.003	25630.827	114336.663
	Quarterly Fire Stations	210699.766	212710.932	.342	.991	.328	-219911.003	641310.536
	Quarterly Population	41.721	6.726	.936	6.203	.000	28.106	55.337
2	(Constant)	-6158203.493	1628145.068		-3.782	.001	-9451437.740	-2864969.247
	Quarterly Service Calls	**-1037.914**	**532.375**	**-.298**	**-1.950**	**.058**	**-2114.744**	**38.917**
	Quarterly Personnel	68268.196	21600.271	.424	3.161	**.003**	24577.523	111958.868
	Quarterly Fire Stations	340026.989	85227.185	.552	3.990	**.000**	167638.736	512415.242
	Quarterly Population	41.125	6.618	.922	6.214	**.000**	27.739	54.510

Moreover, from Table 41 model 2, it can be inferred that the ISFCD's main cost drivers based of predicted average quarterly expenditures are service calls, personnel,

population, and fire stations. Based on the data presented, the best regression model for the ISFCD is the backward elimination method, as shown in Table 39 and Table 41 model 2. As shown in Figure 46, the independence assumption is met for all variables in the backward elimination regression model due to a non-defined linear pattern point distribution.

The multivariate regression model, and predicting the dependent variable, ISFCD average quarterly expenditures, is shown in Equation 4.

Equation 4. Regression Equation for ISFCD Average Quarterly Expenditures

*Average Quarterly Expenditures = (– 6,158,203) - (1,037.914 * Quarterly Service Calls) + (68,268.196 * Quarterly Personnel) + (340,026.989 * Fire Stations) + (41.125 * Quarterly Population)*

The positive coefficients for fire stations, population, and personnel means as these values increase so does the average quarterly expenditures. The coefficient for personnel denotes that for an additional employee, average quarterly expenditures increase by $68,268. Similarly, if population increases by one person, average quarterly expenditures increase by $41. The coefficient for fire station denotes that an additional fire station will cause average quarterly expenditures to increase by $340,027. Lastly, the quarterly service call negative coefficient denotes that for every 1 additional service call, holding all other independent variables constant, average quarterly expenditures decrease by $1,037.

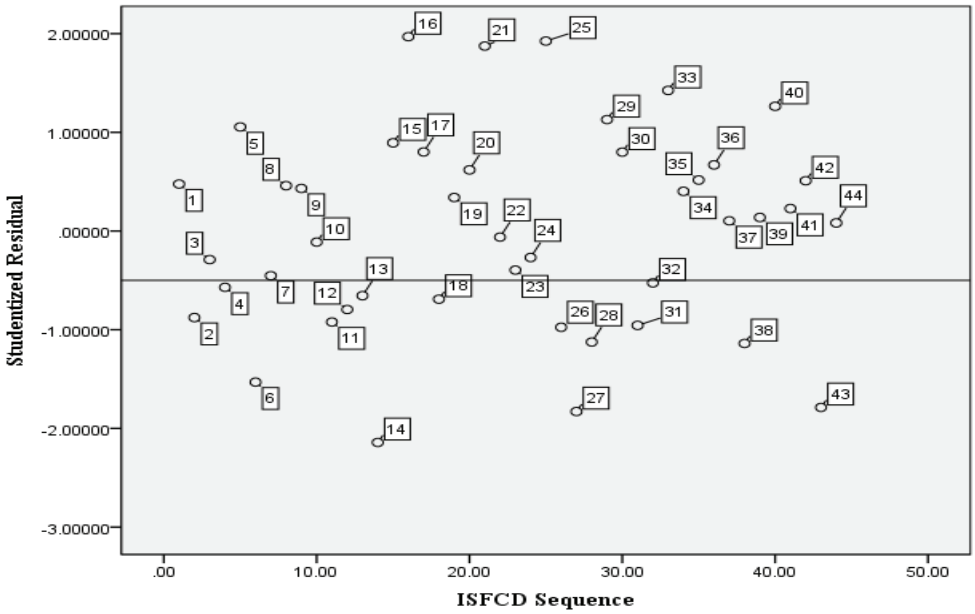


Figure 46. Independence Plot for ISFCD Regression – Backward Elimination Model.

Table 42 model 2 shows the results of several equivalency null hypotheses, which are: (a) no linear relationship exists between the dependent and independent variables placed into the model, (b) all population correlation coefficients are 0 and (c) the population value for multiple R^2 is 0 (Norusis, 2008b). The observed regression significance of .000 is less than .05, thus rejecting the null hypotheses that no linear relationship exists between the dependent variable and the independent variables is appropriate. As reported in Table 41, the null hypothesis that the population coefficients for all the independent variables (except service calls) equals 0 is rejected. According to Table 41 model 2, the independent variable, quarterly service call, displays a 0 in the 95% confidence interval and shows a .058 significance level; thus, this variable is statistically insignificant at the 5% level but significant at the 10% level.

Table 42

ANOVA Summary for Backward Elimination ISFCD Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9648480201003.848	5	1929696040200.770	13.632	.000[a]
	Residual	5379004151322.791	38	141552740824.284		
	Total	15027484352326.639	43			
2	Regression	9585973661130.910	4	2396493415282.728	17.176	**.000**[b]
	Residual	5441510691195.729	39	139525915158.865		
	Total	15027484352326.639	43			

Note. Dependent Variable: quarterly expenses
a. Predictors: (Constant), quarterly population, quarterly fire stations, quarterly personnel, quarterly service calls, quarterly apparatus
b. Predictors: (Constant), quarterly population, quarterly fire stations, quarterly personnel, quarterly service calls

Table 43 provides the supporting analysis for Table 42 and shows the statistically significant correlations among the dependent variable, quarterly expenses, and the independent variables, service calls, square miles, apparatus, and population. As presented in this model, these variables are linearly related to the dependent variable and were not removed from the model, with the exception of square miles, which was removed.

Table 43

Correlation Summary for Backward Elimination ISFCD Regression Model

		Expenses	Service Calls	Square Miles	Apparatus	Personnel	Fire Stations	Population
Pearson Correlation	Expenses	1.000	.446	.	.254	-.001	.245	.690
	Service Calls	**.446**	1.000	.	.329	-.212	.263	.747
	Square Miles	**.**	.	1.000	.	.	.	.
	Apparatus	**.254**	.329	.	1.000	-.686	.957	.105
	Personnel	**-.001**	-.212	.	-.686	1.000	-.693	-.115
	Fire Stations	**.245**	.263	.	.957	-.693	1.000	.070
	Population	**.690**	.747	.	.105	-.115	.070	1.000
Sig. (1-tailed)	Expenses	.	.001	.000	.048	.498	.055	.000
	Service Calls	**.001**	.	.000	.015	.084	.042	.000
	Square Miles	**.000**	.000	.	.000	.000	.000	.000
	Apparatus	**.048**	.015	.000	.	.000	.000	.248
	Personnel	**.498**	.084	.000	.000	.	.000	.230
	Fire Stations	**.055**	.042	.000	.000	.000	.	.326
	Population	**.000**	.000	.000	.248	.230	.326	.
N	Expenses	44	44	44	44	44	44	44
	Service Calls	44	44	44	44	44	44	44
	Square Miles	44	44	44	44	44	44	44
	Apparatus	44	44	44	44	44	44	44
	Personnel	44	44	44	44	44	44	44
	Fire Stations	44	44	44	44	44	44	44
	Population	44	44	44	44	44	44	44

Prior to examining the models' independent variable coefficients and writing the estimated regression equation for the predicted change in quarterly expenditures, the following attributes are analyzed: (a) tolerance and multicollinearity, (b) normality, (c) leverage, (d) constant variance, and (e) partial regression plots.

The tolerance and variance inflation factor (VIF) values, as shown in Table 44, model 2 are greater than 0.1, indicating the models' independent variables have little of their variability explained by the other independent variables. Also, the VIF values are relatively large (>1), indicating the variables are not highly correlated with each other (Norusis, 2008b).

Table 44

ISFCD Tolerance and Multicollinearity Summary – Backward Elimination

		Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)					
	Quarterly Service Calls	.446	-.315	-.198	.366	2.729
	Quarterly Personnel	-.001	.460	.310	.508	1.969
	Quarterly Fire Stations	.245	.159	.096	.079	12.669
	Quarterly Apparatus	.254	.107	.064	.076	13.206
	Quarterly Population	.690	.709	.602	.414	2.415
2	(Constant)					
	Quarterly Service Calls	.446	-.298	-.188	.397	2.519
	Quarterly Personnel	-.001	.452	.305	.515	1.942
	Quarterly Fire Stations	.245	.538	.384	.485	2.063
	Quarterly Population	.690	.705	.599	.422	2.372

Note. Dependent Variable: quarterly expenses

Figures 47 and 48 confirm that the regression model for predicting annual ISFCD fire expenditures comes from a normal distribution. Figure 47 shows the residuals falling close to or on the straight line, and Figure 48 shows the assumption of equal variances is met as the distribution moves in a linear fashion for the observed ISFCD expense values.

The leverage statistic, according to Norusis (2008b), identifies cases of unusual independent variable values. The statistic measures how far the values of a case are from

the means of all independent variables. As depicted in Figure 49, there are no values close to 1; thus the models' independent variables possess no unusual values across their means.

Figure 50 shows the constant variance for the dependent variable to be the same for all the independent variable values used in the model as there is a randomly displaced pattern of data points around a horizontal line through 0. If the constant variance assumption is violated, there would be a distinct pattern in the data points (Norusis, 2008a).

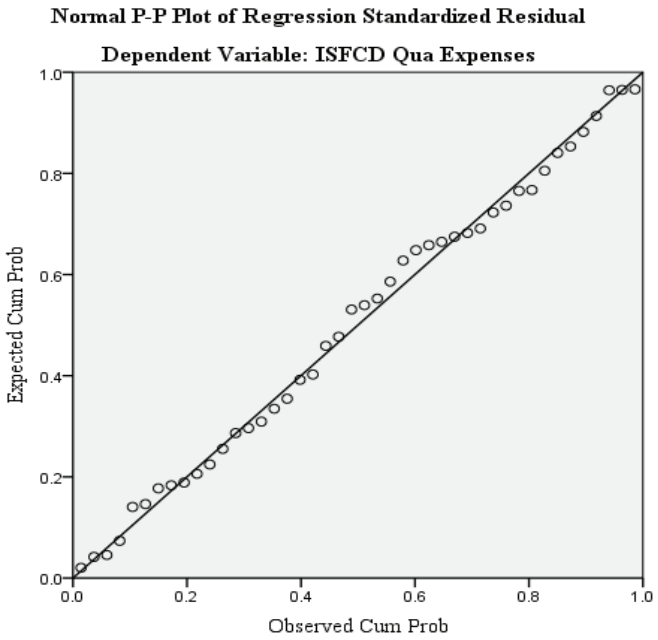


Figure 47. P-P Plot of ISFCD Standardized Residuals.

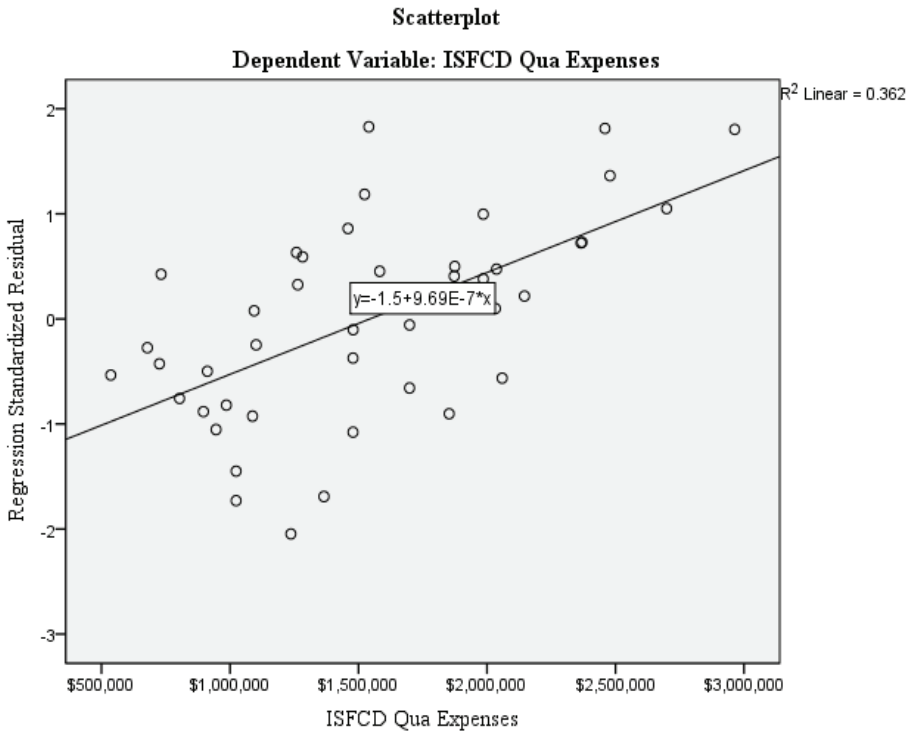


Figure 48. Scatterplot of ISFCD Predicted and Observed Values.

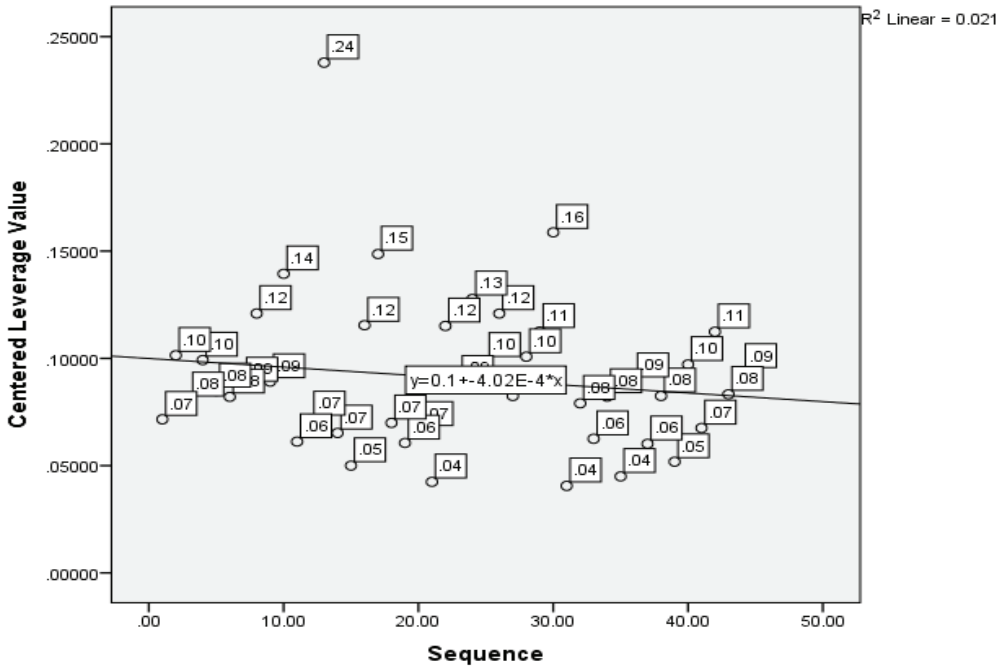


Figure 49. ISFCD Leverage Points for the Independent Variables.

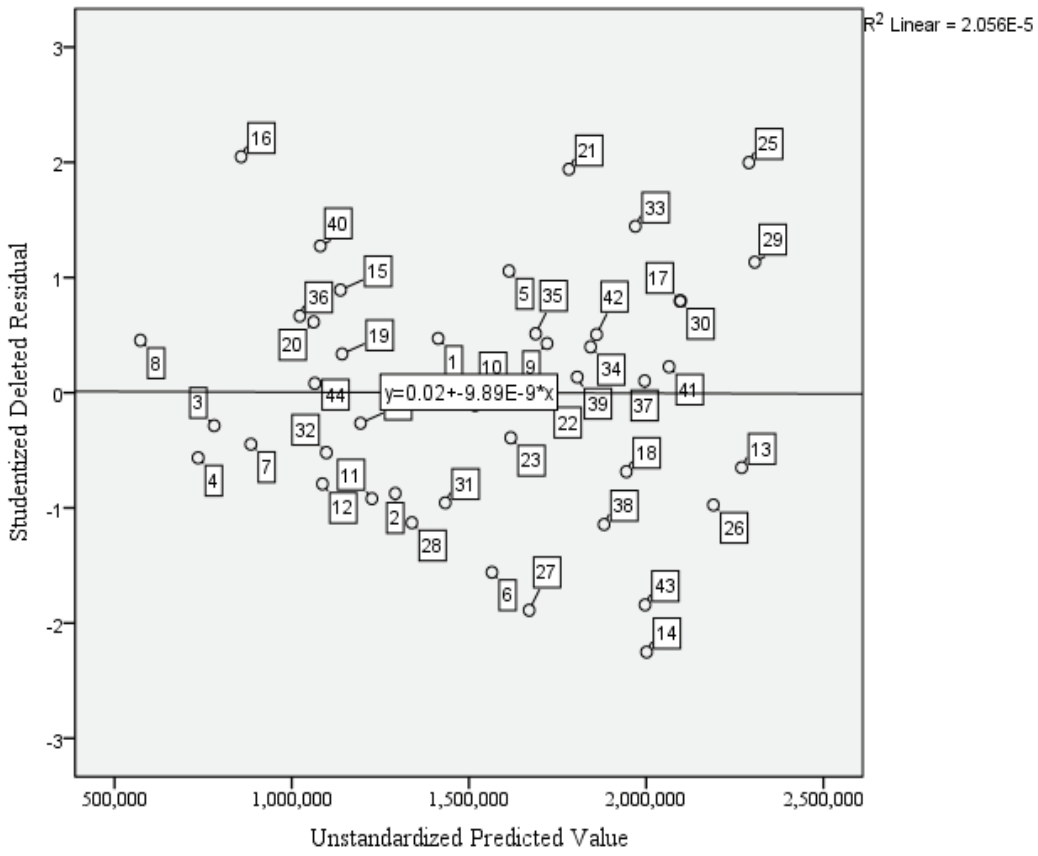


Figure 50. Scatterplot of Studentized Deleted Residuals versus Unstandardized ISFCD Quarterly Expenditure Predicted Values.

The last regression diagnostics to assess the adequacy of the ISFCD model presented are displayed in Figures 51 and 52. These figures are partial regression plots of the residuals from the predicting quarterly expenditures from all the other independent variables except service calls and population, respectively. Because the assumption of linearity is met, the partial regression plot is linear (Norusis, 2008a).

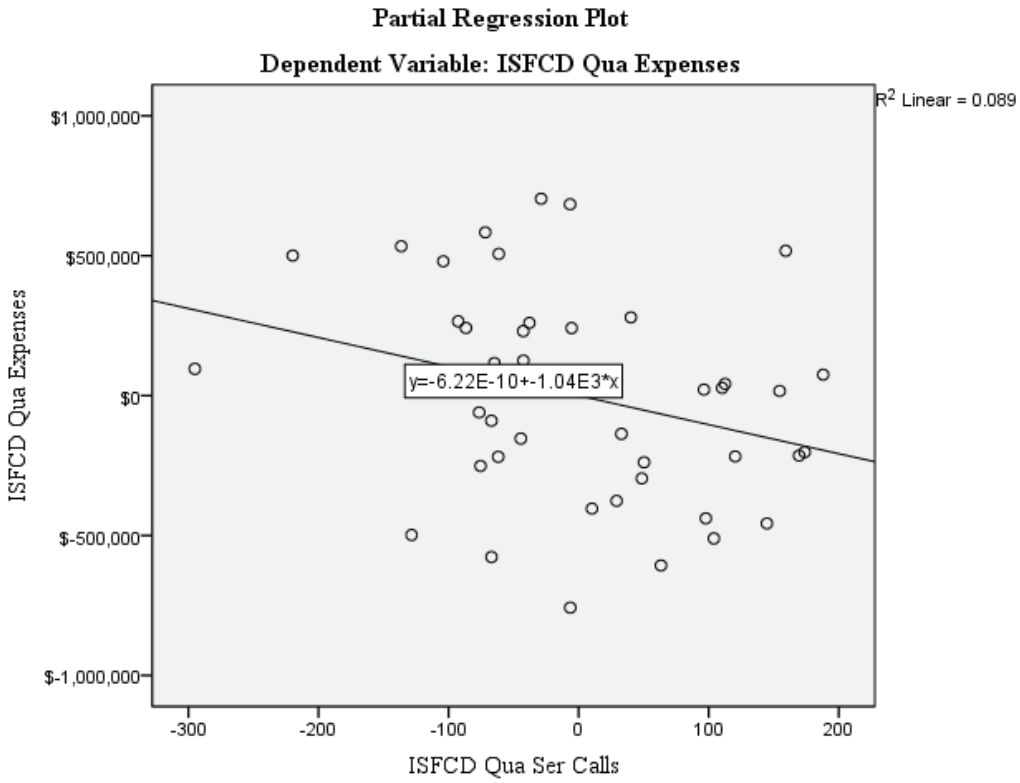


Figure 51. Partial Regression Plot for ISFCD Quarterly Expenses versus Quarterly Service Calls.

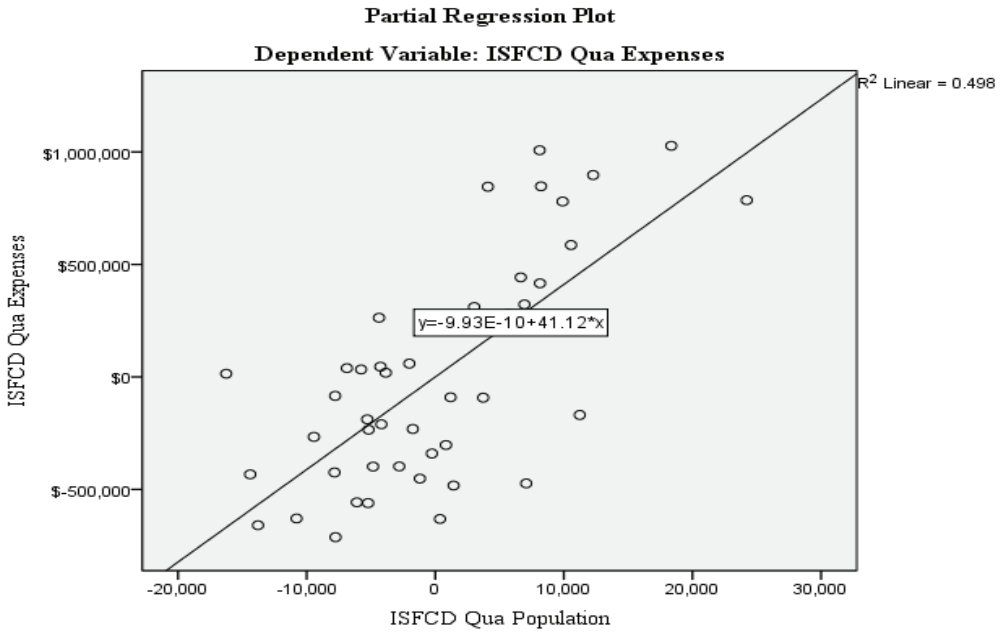


Figure 52. Partial Regression Plot for ISFCD Quarterly Expenses versus Quarterly Population.

With the multivariate regression modeling complete, the following qualitative section will be used to fill in gaps that remained after the quantitative analysis. The qualitative section includes the following: (a) state of Florida ISA arrangements, (b) types of county-wide ISA and network partnerships, and (d) integrated fire service design causal network variable list.

Qualitative Findings

State of Florida ISA/Mutual Aid Arrangements

With respect to the State of Florida Emergency Operations Center (EOC), the county fire chief is the authority having jurisdiction (AHJ) and is the individual who bears the responsibility for declaring a state of emergency within the county system, which includes the city and ISFCD fire departments. This individual serves as the county's emergency management director per Florida State Statute 252.38, and is the authoritative figure head speaking with state EOC representatives to commence procuring assistance from the state level to ensure the county has the appropriate resources and services to mitigate and control the emergency. Though the county fire chief is responsible for declaring a state of emergency to the State of Florida EOC on behalf of the city and ISFCD, the city and ISFCD fire chiefs retain authoritative control over their respective jurisdictions' EOC. In essence, regardless of the emergency scene location, the county fire chief becomes a liaison for the city and ISFCD fire departments when the State EOC is needed within those jurisdictions.

The county fire chief, per Florida State Statute 252.40, is authorized to develop and enter into mutual aid arrangements within the state for reciprocal assistance aid when local resources become overwhelmed during emergencies. Depending on the incident and

the damage severity, these interactions could lead to another relationship with the Federal Emergency Management Agency (FEMA) through the State of Florida EOC and the Governor's Office, thus completing the intergovernmental link of local, state, and federal relations (personal communications, August 2015).

County-wide ISA and Network Partnership Arrangements

One type of ISA arrangements implemented at the local level consists of voluntary mutual and automatic aid agreements between the county, city, and ISFCD fire departments. For example, mutual aid consists of the county fire/EMS agency asking for additional personnel and resource assistance from other agencies through the 911 dispatch center after the initial resource deployment to the emergency. Contrarily, automatic aid is an immediate resource deployment of certain emergency-type apparatus and/or personnel from another agency as soon as the emergency is dispatched from the 911 center. In essence, within automatic aid type arrangements, the 911 dispatch center immediately dispatches certain resources from multiple jurisdictional partners. In mutual aid arrangements, the county fire/EMS agency requests resources from specific jurisdictional partners (through the 911 center), based on dynamic evolving events at an established emergency scene (personal communications, August 2015).

Other types of ISA arrangements in which the fire chiefs are involved are shown in Figures 53, 54, and 55 in which a vast array of network partnerships entered into by the respective fire agencies; however, the county, by virtue of their organizational size, are involved in more. The ISAs range from voluntary service agreements with several community partners, land/facility lease arrangements with other fire agencies, and intra-departmental resource sharing within the county and city.

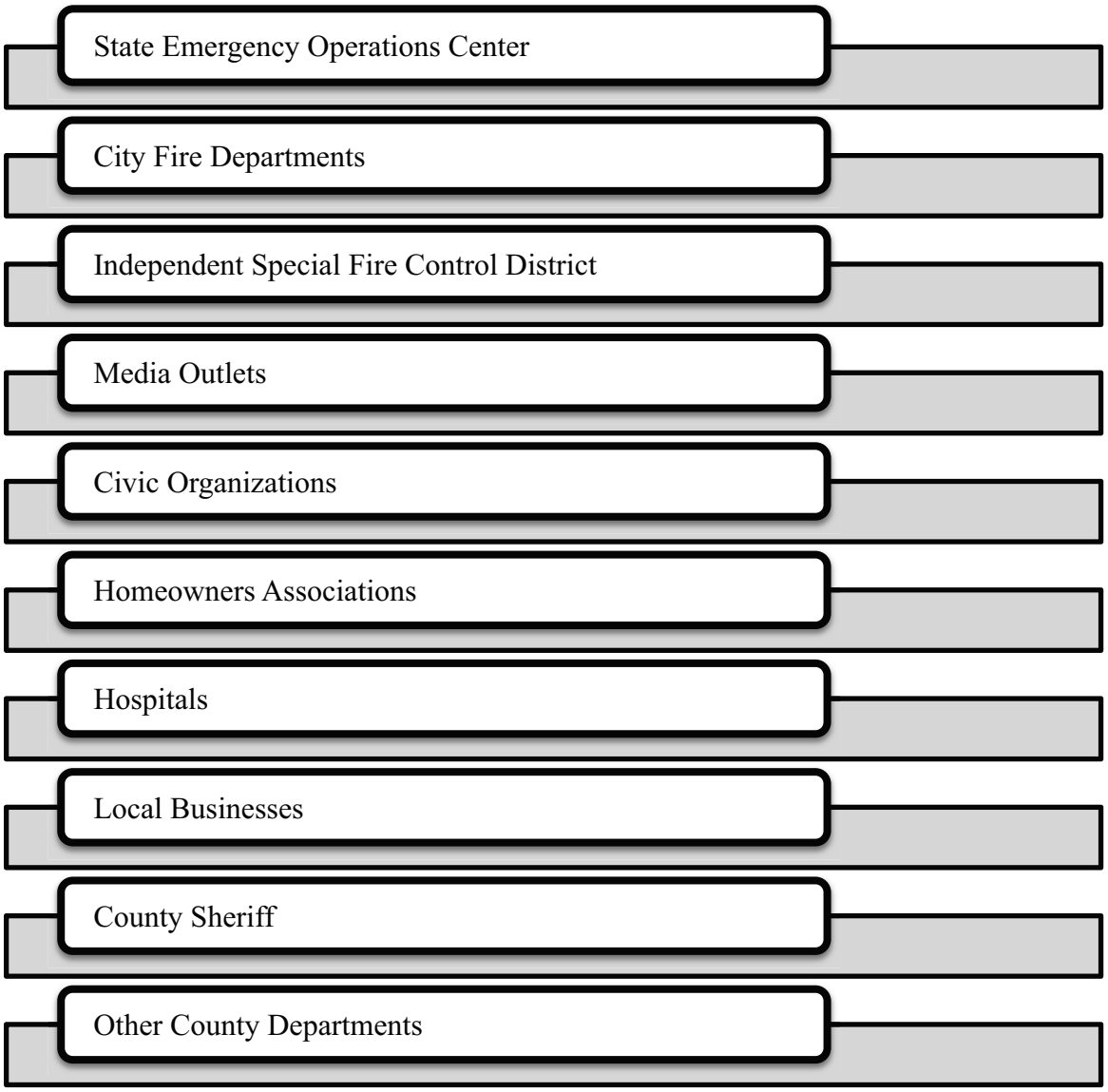


Figure 53. County Fire ISAs and Network Partnerships.

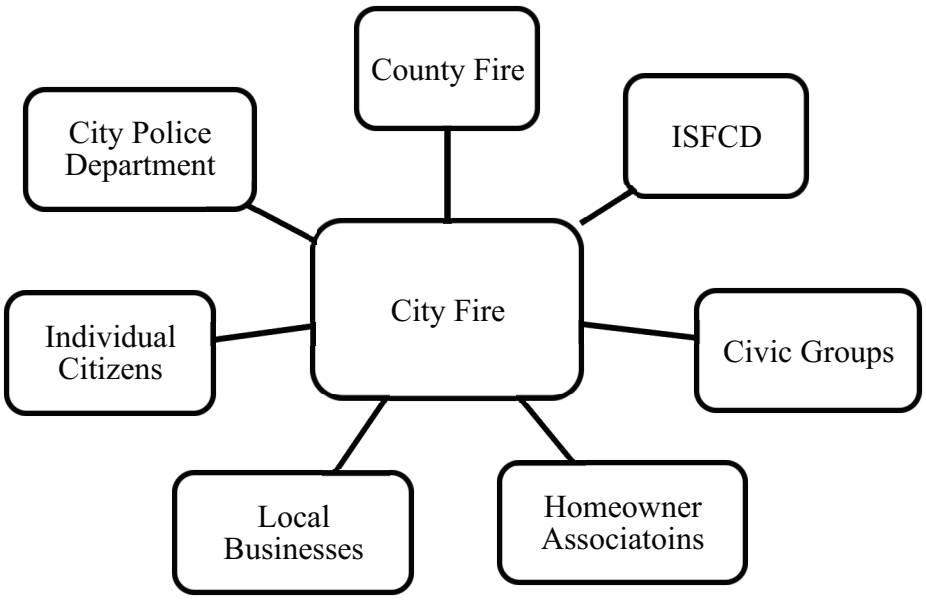


Figure 54. City Fire ISAs and Network Partnerships.

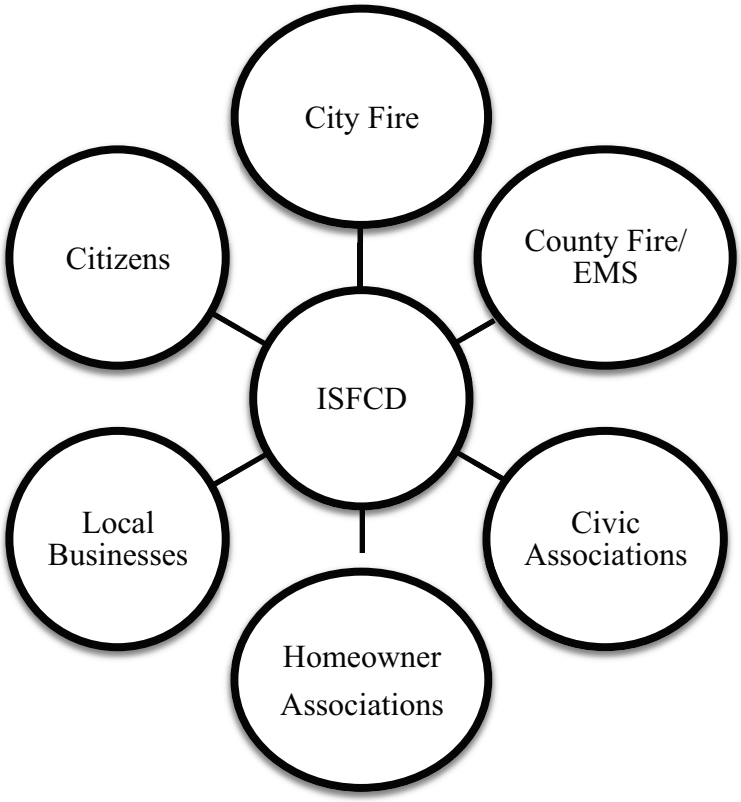


Figure 55. IFSCD ISAs and Network Partnerships.

Regarding ISA development between the county, city, and ISFCD, various service needs were recognized due to population growth in certain areas, coupled with different land development and building patterns throughout the county. Based on the respective fire department's jurisdictional boundaries, nature of emergency call types, and the emergency location, it became a natural progression for each agency to begin assisting one another for the betterment of the community. The intervening variable for this natural progression was response time to the emergency incident regardless of an agency's boundaries. In turn, this led to the voluntary mutual and automatic aid agreements (personal communications, August 2015)

The purpose and function of the mutual aid agreements is to maintain current service levels throughout the county. When mutual aid is requested from a neighboring jurisdiction it is because current resources used to mitigate the emergency are exhausted, and additional resources are required to aid in bringing the situation under control. Second, pockets of the community are devoid of response apparatus due to the initial emergency, and mutual aid response units coming into a specific boundary maintain service levels for concurrent emergency calls (personal communications, August 2015).

Moreover, the automatic aid agreements do increase the community's service levels. The reason for automatic aid increases, rather than maintaining at the same service level, is that the other jurisdiction (i.e., donor) immediately provides apparatus and personnel to a given jurisdiction based on pre-planned emergency types. These type of emergency calls can happen once a day or several times within a 24-hour shift, thus depleting the donor's fleet and human resources on a dynamic basis. These reciprocal relationships are provided throughout the county with an understanding that all agencies

assist each other to ensure every resident, without regard for jurisdictional boundaries or cost, receives an equitable service level (personal communications, August 2015).

The need for cost savings is a component of the life-safety equation; however, cost is secondary in comparison to saving lives throughout the community. Being prepared and ready-to-respond to all emergencies in an effective and efficient manner is the overarching factor. Efficiency in this sense is not necessarily the lowest cost per unit per response; rather, having the proper allocation of resources and personnel to mitigate a given emergency situation is priority one (personal communications, August 2015).

The cost savings component is a factor when a major incident like a commercial or wildland-urban interface fire, a trench rescue, or hazardous materials emergency occurs. These emergency types allow for automatic aid response and use of multi-jurisdictional apparatus and personnel; hence, the savings in overtime costs. Again, the monetary cost savings are a priority, but the overarching savings is not monetary, it is human lives and community. The ISAs from an emergency response perspective are ultimately a safety factor for the emergency response crews and the citizens being served. The intent is to provide the highest crew safety levels while placing the appropriate staffing and apparatus types on scene in an acceptable time to mitigate the emergency situation (personal communications, August 2015).

With a different emergency response skill set required to handle a plethora of emergency situations comes the need for personnel specialization in many tactical areas. This specialist conundrum and evolving service environment drives the voluntary ISAs within the jurisdictions and throughout the entire fire service community. There are few emergency response agencies with appropriate full-time staffing levels to mitigate all

emergency types; hence, the importance of everyone working together to ensure crew and citizen safety (personal communications, August 2015).

New ISAs are emerging based on service demand loads and changing building construction industry dynamics. As more vacant land is developed into commercial, multi-family, and industrial usage, the need for confined space and trench rescue services are becoming imminent. Currently, there is a new coordinated effort among multi-jurisdictional partners to form a regional trench rescue team (TRT). The TRT is conducting quarterly training scenarios and working with current specialized technology to learn communication and situational awareness skills for various emergency scenario types within the region. These trust building exercises create partnerships that provide the community, citizen, and industry with a higher level of service not achieved through any one agency (personal communications, August, 2015).

Figure 56 is a systems pictorial of the steps involved in trust building based on a reciprocal understanding that a deficiency exists within a service function – in this case response time. This figure highlights the multitude of nodes (i.e., building blocks) required upon recognizing a service need deficiency exists, and, before ISA development occurs to mitigate the situation. The ISA development could take days, weeks, or months, depending on the situation specificity, but the overarching importance is trust building based on mutual confluence, problem recognition and definition, and then, partnership creation for achieving higher service levels (personal communications, August 2015).

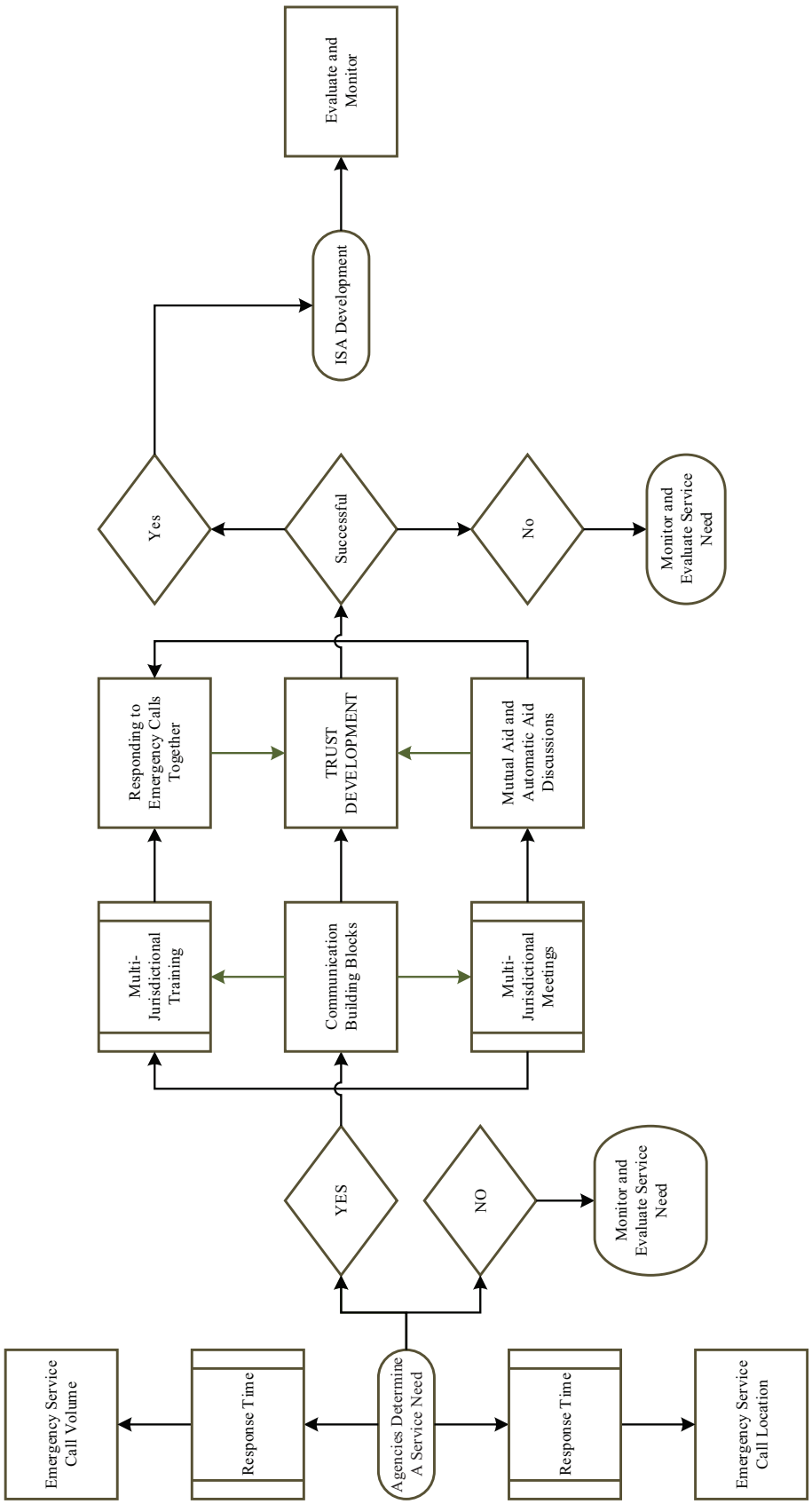


Figure 56. Integrated Fire Service Design Event-State Trust Network.

To further expand service levels, certain county fire agencies are currently working on a third automatic aid agreement with another county. As counties continue to grow and diversify, the importance of working together is paramount, and the ability for resource sharing becomes greater as demand for service levels increase. The flexibility afforded by immediately coordinating personnel and emergency resources benefits all organizations involved; moreover, it is a life-saving mechanism for the citizenry (personal communications, August 2015).

Like the voluntary mutual and automatic agreements, the community partnerships are not formal agreements; they are relationships built over time on trust and goodwill. They provide a communication medium for the fire departments to educate the citizenry on service levels, funding initiatives, and disaster preparedness issues. For example, the media is a communication medium to reach mass audiences with respect to public education campaigns (e.g., public safety announcements) and emergency incidents. As emergency incidents evolve, there is real-time information provided to the community that provides important safety updates. Moreover, the community relationships allow feedback from the various survey material distributed on how well services rendered meet citizen satisfaction. This communication method allows for citizen analysis and reflection into their respective fire department's service delivery model (personal communications, August 2015). An example of a community/citizen survey used in the researched county is provided in Appendix E.

Intra-Governmental Partnerships

The intra-governmental partnerships are voluntary service arrangements between the fire and police agencies to increase service levels and avoid duplication of service.

One example is the dive and boat response service provision areas. When an emergency regarding boat and dive operations exist within the city's borders, fire and police work together with staffing and resources to mitigate the emergency situation. This shared responsibility provides an effective and efficient means to handle emergencies while ensuring duplication of effort is minimized while maximizing taxpayer dollars. The positive outcomes associated with this partnership includes, but not limited to, (a) enhanced on-scene radio communications, which leads to overall better scene safety; (b) multi-agency training and resource integration, which leads to better scene coordination and incident command structure; (c) potential for increased federal grant monies due to multi-agency coordination and resource sharing; (d) positive community relations; (e) trust building among street-level and incident command personnel; and (f) increased potential to save more lives and property through reasons stated previously (personal communications, August 2015).

Upon completing the interviews, several themes emerged regarding why and how ISAs came to fruition within the three fire departments. The next section highlights those themes through generation of a causal network variable list.

Integrated Fire Service Design Causal Network Variable List

As shown in Table 45, economies of scale, or monetary considerations, was not an impetus behind instituting ISAs within the respective emergency response borders; rather, the overarching theme is ensuring first responders' safety on emergency scenes.

Table 45

Integrated Causal Network Variable List #1

Antecedent or Start Variable	Mediating Variables	Outcomes
Recognized Service Need	Response Times	Multi-jurisdictional Training
Scene Safety	Fire Station Location	Multi-jurisdictional Chief Officer Meetings
Major Incidents	Emergency Call Location	Multi-jurisdictional Committees
Inadequate Scene Staffing	Emergency Call Types	

As shown in Table 46, the emergency scene safety theme lead to several multi-jurisdictional components (e.g., training and committees) which, evolved into as displayed in Table 47, an outcome from the trust building start variable. However, as listed in Table 47, a final outcome from the causal network list is a generated savings component from no overtime spending on certain emergency incident types. The overtime savings stem from automatic aid response procedures where personnel and apparatus utilization are deployed immediately during a multi-jurisdictional response.

Table 46

Integrated Causal Network Variable List #2

Antecedent or Start Variable	Mediating Variable	Outcomes
Multi-jurisdictional Training	Formal Communication Channels	Intra-county Response
Multi-jurisdictional Chief Officer Meetings	Informal Communication Channels	Dispatch Protocol Adjustments
Multi-jurisdictional Committees	Personnel Staffing Qualifications	Trust Building

Table 47

Integrated Causal Network Variable List #3

Antecedent or Start Variable	Mediating Variable	Outcomes
Intra-county Response	Informal Automatic Aid Response	Overtime Savings on "Major Incidents"
Dispatch Protocol Adjustments	Informal Mutual Aid Response	Formal ISAs
Trust Building		Decreased Response Times
		Increased Scene Safety
		Increased Personnel Safety

Significant Interview Answers Relating to the Quantitative Analysis

The significant qualitative findings as they relate to the quantitative results provide the foundation for the centralized versus decentralized fire service organizational design causal model. The face-to-face interviews provided the contextual depth and breadth of knowledge not found in statistical analyses alone, while adding thematic conversational factors that provide a starting point for future research beyond the scope of this paper. Moreover, the answers provided by the fire chiefs were not influenced from the statistical results as the multiple linear regression analyses were not started at the time of the interview phase; thus enhancing the study's internal validity of causal inference. In essence, the quantitative and qualitative results were independent from each other.

Interviewing the county fire chief revealed that the possibility of achieving internal efficiencies might be dependent upon analyzing fire apparatus response matrices in conjunction with adjusting the 911 run cards from the dispatch center. The decrease of predicted annual expenditures as emergency service calls increase might be a result of the county's efforts to adjust their emergency response matrices, or it could be a result of the

ISFCD providing more apparatus and personnel on mutual or automatic aid assignments into the county's jurisdiction. As revealed during the ISFCD interview, the fire chief stated they respond to four additional emergency service calls outside their jurisdiction for every one received inside their boundaries; however, the location of those calls was not determined during this study (personal communications, August 2015).

The second major finding within the county organizational design not revealed by statistical correlation was the number of individuals directly reporting to the county fire chief. The city and ISFCD achieve a 1:3 and 1:2 span of control ratio, respectively, however, the county employs a 1:9 span of control ratio. Unlike the city and ISFCD organizational designs, the county fire chief leads and manages individuals outside the fire and EMS arenas. From a cost driver perspective on the predicted quarterly and annual expenditures, further qualitative research (e.g., a second round of interviews) needs to delve into how this ratio influences personnel costs as depicted from the quantitative results (personal communications, August 2015). The chain-of-command charts are located in Appendix F.

Lastly, the ISFCD's most significant interview finding as related to the quantitative results included the cost driver personnel and, possibly, apparatus variable. Though fire apparatus was not in the final regression model as shown in Table 44 model 1, the coefficient of 107,703 against the dependent variable quarterly expenditures requires further research as the ISFCD fire chief revealed that their department provides a 4:1 response ratio when dealing with mutual aid service calls (personal communications, August 2015). Further quantitative and qualitative research needs to delve into the ISFCD 4:1 response ratio influences on the apparatus, personnel, costs per capita, and cost per

square mile drivers as inferred from this study's regression results. The large ratio of mutual aid given requires greater output measurement (i.e., enhanced emergency service call tracking) and budgetary controls on a respective agency as cost fluctuations in personnel, apparatus, cost per square mile, and cost per capita are influenced when first responder services are provided in this manner.

The aforementioned is the reason for purposefully not using cost per capita and cost per square mile in the ISFCD regression models. As was shown in Table 39 model 2, with the R^2 of .638 there is 36.2% (1-.638) of the proportion of variability of the dependent variable not explained by the regression model. Researching the remaining variability in average quarterly expenditures is beyond the scope of this paper; however, uncovering this finding as it relates to mutual aid service calls is paramount for future scholarly papers. In essence, determining what is driving the mutual aid response matrix and how quarterly expenditures relate to these new variables may explain the remaining 36.2% variability.

With the data analysis section complete, Chapter 5 discusses the study's implications within the practitioner arena and the public choice theory literature stream. This is followed by the study's limitations and delimitations, concluding with recommendations for future research.

CHAPTER V. PRACTITIONER AND THEORETICAL IMPLICATIONS & LIMITATIONS

Practitioner Implications

Undoubtedly, the events of September 11, 2001 have placed financial hardships and created intense service challenges for federal, state, and local-level governments. First responders within the intergovernmental matrix have important roles in mitigating emergency situations; however, for a large percentage of emergency situations it is the local-level first responders who provide the first line of defense against terrorism and other disasters confronting our nation. The new service missions place great strain on finite financial and personnel resources, and government officials must balance homeland security initiatives with traditional police, fire, and EMS issues. As a result, government officials at all levels and from multiple disciplines are attempting to find new methods for conducting emergency service initiatives.

This paper is an expansion of the current scholarly literature in finding that new way to conduct business within the dynamic and stochastic first responder environment. Specifically, the current study delved into various fire service organization designs to uncover scale economies in relation to emergency service calls. Moreover, the research sought to provide citizens, elected officials, and fire service officers with scientific analyses on what variables drive the consolidation discussion, and whether consolidating multiple fire departments into a larger agency is the most effective and efficient use of taxpayer dollars.

In this study, the consolidated county and decentralized ISFCD fire agencies did achieve economies of scale as predicted – quarterly expenditures decrease while quarterly emergency service calls increase. For the county and ISFCD fire departments, the predicted quarterly expenditures decrease by $68 and $1,037, respectively, as emergency service calls increase. Moreover, the county and ISFCD fire service organizational designs in this study pay less than the city fire department per square mile. The city's quarterly expenditures per square mile covered are three and two times more than the county and ISFCD, respectively, to provide fire service. Following the same linear pattern, the city's cost per capita is $15 more than the larger ISFCD, and only $9 less than the much larger county fire department.

The importance for elected officials and fire service officers to understand in regards to the aforementioned costs, specifically when communicating budgetary appropriations and service levels to the citizens, is to include the following components into the conversation: (a) regardless of organizational design, the size in square miles of the area served; (b) the permanent population of the area served, coupled with seasonal population fluctuations; (c) the fluctuations in emergency service calls and resource utilization factors (personnel and apparatus) during seasonal and non-seasonal population changes; (d) within the square miles covered, identification of the building occupancy types (i.e., commercial, multi-purpose, residential), and occupancy density; (e) state or local statutes that need to be followed to conduct business properly and legally; (f) national fire protection standards adopted by the fire department; (g) the chain-of-command ratios; and, (h) potential joint-purchasing arrangements (e.g., fire hose, personal protective equipment, and rescue tools).

Regarding the chain-of-command, the county fire department employs a 1:9 supervisor to subordinate ratio at the fire chief level. The county fire chief supervises nine administrative personnel, of whom several do not come under the traditional auspices of fire/EMS. The preferred supervisor to subordinate ratio is 1:5. Therefore, the cost, service, and personnel implications in relation to the organizations' hierarchical structure are important components to consider when discussing fire service consolidation. As such, the following questions concerning the current organizations' hierarchy need answering: (a) What is the organization's stated mission? (b) What is the ability to properly accomplish the organization's mission while supervising more than five individuals? (c) Are authorized full-time equivalent positions not getting filled or replaced that should be? and (d) Are there any worker productivity or moral issues?

Another important component in the fire service economies of scale debate that was discovered during this study is the importance of community and citizen support. During the interviews with the county, city, and ISFCD it was revealed that great emphasis is placed on ensuring the citizenry have a voice in their fire department operations. The fabric of their identities are developed through community relationships and partnerships built over many years. Building community relations is a priority for the elected officials in all jurisdictions, and that sentiment pervades down throughout the organizational structure. For example, the city fire department, through its annual spending appropriations, fulfills the community relationship mission by allocating dollars, personnel, and resources to raise awareness on emergency medical issues and fire service related matters. This type of public involvement is about giving back to those being served.

In accordance with that philosophy, the ISFCD provides a citizen satisfaction survey to its residents and collects information on how well they provided service. They also collect information on other services that the citizen may or may want to exclude. This type of honest and transparent feedback is paramount in the fire service conversation, and particularly helpful during times of consolidation conversations. As discussed in Chapter 1, residents living in affluent portions of a given jurisdiction do not always favor fire service consolidation for fear their tax dollars will get redistributed to less affluent areas in conjunction with a concurrent service level decrease. This tension becomes a major hurdle for elected officials and fire service officers to contend with as the global demand for emergency services is increasing, coupled with citizens' expectations that their tax dollars are being allocated properly.

The tax dollar allocation component is important for all stakeholders to grapple with during fire service consolidation discussions, specifically in the mutual and automatic aid arena. The ISFCD fire chief stated that their mutual aid given to receive ratio is 4:1; meaning they respond to and provide personnel, apparatus, and associated equipment four times more into neighboring jurisdictions for every one resource complement received into the ISFCD jurisdiction. A resource complement varies, is emergency situation specific, and is requested by the agency requiring assistance. For example, a resource complement might consist of one fire engine, one fire engine and one ladder truck, a fire boat, or any combination thereof. In essence, the ISFCD is a donor provider with respect to mutual aid response.

The donor concept is important to the elected officials and policy decision makers as it relates to the consumption and production/provision of fire service. These inter-

jurisdictional spillovers, or negative externalities, can create a false community service demand while understating the true societal service demand. This concept is evident in the terrorism and natural disaster arenas where certain population segments are not as capable to handle such emergencies without continuous outside agency assistance; this occurs at the local, state, national, and international levels.

This service demand conundrum raises another set of questions for the local elected officials and practitioners to solve. These include: (a) Who is receiving the benefit of mutual aid? (b) What is the total annual cost for mutual aid service provisions? (c) What percentage of the time are personnel and fire apparatus protecting outside their borders? (d) What is the number of concurrent service calls inside the agency's borders? and (e) What is the difference in unit response time if that fire/EMS unit had been in quarters versus on a mutual aid response (assuming another response unit did not move-up to backfill the empty fire station)?

Analyzing and answering the aforementioned questions aid the fire service professionals in the consolidation conversation and ISA development. As shown in this research, multi-jurisdictional coordination in supplying fire/EMS services can be achieved through government agency negotiations as a result of internal pressures to achieve optimal efficiency. External pressures also lead to optimal efficiency; however, the findings from this research concluded internal competitive pressures provided the impetus for ISA development. In turn, the ISA development produced service efficiencies, not necessarily technical efficiencies as cost per unit of output but, rather, allocative efficiencies in regards to having the correct and appropriate resources on an emergency scene to mitigate the situation properly.

Public Choice Theory Implications

Individuals supporting public choice theory profess that government competition and decentralized local governments promote greater technical efficiency and responsiveness in providing public services. Public choice theorists contend that the existence of several competing governments offering an assortment of services at various price points provides a market-like system for residents and businesses to choose a given jurisdiction over another. This competitive spirit creates an atmosphere where fragmented jurisdictions compete against each other to produce and provide a given level of public service.

The market-like competitive efficiency mechanisms, as described in this research, lead to enhanced organizational performance. Internal competition was the necessary component to achieve enhanced organizational performance through ascertaining allocative and sometimes technical efficiencies. The former deals with ensuring appropriate responsiveness in meeting public preferences in resource allocation, while the latter is concerned with achieving the production of services at minimum cost. In this research, most of the service provision efficiency maximizations include the following resource allocation measures: (a) better response times, (b) personnel safety, (c) emergency dispatch protocol adjustments, (d) fire-ground training improvements, (e) scene safety, and (f) resource and personnel utilization enhancements within the incident command system. The technical efficiency improvement, as highlighted during the interview portion of this research, is the cost savings achieved per unit of output on major emergency events such as wildland/urban interface fires, large commercial fires, boat and dive emergencies, and hazardous materials incidents. The three fire chiefs all agree one

of the most beneficial components to their ISAs is resource sharing for the betterment of the community, first responder personnel, and citizens served. The ISA resource sharing component provides technical and allocative optimal maximization efficiencies.

The public choice purists contend that public agencies operate in a competitive light and act in a non-selfless manner for the citizens' benefit. As demonstrated in this study, the system of public administration concerning the provision and production of fire and EMS service is composed of various organizational designs, centralized and decentralized, working within voluntary cooperative arrangements for the betterment of the public welfare and first-responder safety. A result of this research, specifically enhancing the public choice perspective is the ISFCD's customer service satisfaction survey.

As learned through the extant literature, one of the major economic rationales for promoting a centralized consolidated structure is not economies of scale; rather, it is the absence of adequate service levels. The need to consolidate fire departments may not emanate from the need to achieve the lowest cost per unit; instead, it is to provide a safer and better service to the citizenry. A result of this research, it shows that in addition to achieving scale economies and possessing the highest quarterly cost per emergency response by over $1,300, the residents within the ISFCD rate their service level adequacy overwhelmingly excellent to outstanding. After reviewing over 50 customer satisfaction surveys, the residents within the ISFCD said their fire department was helpful, courteous, and professional. Other common themes were outstanding service levels with competent personnel and great response times. This form of mutual information exchange creates open communication channels that make the fire service more effective and responsive to

the citizenry. Moreover, this form of communication allows for public servants to remain accountable to their constituency.

The public involvement, as demonstrated through the customer satisfaction surveys, promotes the essence of public choice's theoretical foundation. The ability for the public to choose its location based on a prescribed set of public goods that satisfies their wants is the public choice spirit. In this case, the cost/benefit calculus for the ISFCD residents is not a concern, as paying a higher average quarterly cost per emergency response does not appear to be an issue as long as the service quality remains constant.

Limitations and Delimitations

The main limitation of this study is the confinement to 1/67th of Florida counties. The ability to generalize the study's findings to other regions in the United States is limited as only three fire chiefs were interviewed, coupled with analysis of the same financial and budgetary information and ISAs relating to emergency response procedures within the fire/EMS agencies. The same agencies possess voluntary arrangements with other network actors outside the scope of the fire service, such as hospitals, civic associations, state agencies, and private businesses.

Regarding the fire chiefs interviewed and the ability to generalize the study's findings to other regions, it is important to note that their interpersonal dynamics and long-tenured working relationships have aided positively in the ISA development processes. The aforementioned results enjoyed in the researched county may not be achievable in other regions without the same working relationship dynamic built over many decades.

Another limitation of the study's findings to other localities in the United States is related to the specific county researched. The findings from this study are specific to the county's population, economic, and building climate during the fiscal years researched. Another county with similar fire organizational designs may have completely different financial and budgetary requirements, different building code practices that influence new construction activities, and different government taxing structures affecting revenue streams that influence the emergency service delivery models. Moreover, the findings are specific to the study's past and current fire chiefs' ability to garner support for the type of ISAs in effect at the time of this research.

The last limitation of this study includes a lack of response time data to compare organizational design effectiveness. The fire chiefs espouse allocative efficiency measures are priority in serving their personnel and citizen base, and response times measures a component of that service effectiveness. Having recognized that, a driving impetus for entering into voluntary ISAs, as revealed in this study, is the insufficient response times in certain portions of the agencies' response areas. The fire chiefs recognized a need and took appropriate measures to overcome spatial and logistical deficiencies in their organizational structure. The future research inquiry becomes whether those measures are appropriate, adequate, and meeting the rising demands of the service challenges confronting public safety officials.

To further confront the fire/EMS service challenges, future research must overcome this study's major delimitation; that is, the sample size used for generalizing to a larger population. Due to time, resource constraints, and logistical reasons, only three fire agencies were sampled. However, future scholarly endeavors have a baseline from

which to operate, and can add to this research by incorporating additional fire service agencies. Another difficulty in replicating this research includes the face-to-face interviews that entails significant traveling throughout the state.

To remain focused on the pertinent variables related to economies of scale, this research does not include certain cost attributes such as union contract and labor disputes, certain capital expenditures, and pension-related issues. These limitations need consideration in future studies as policymakers attempt to decide whether consolidation is appropriate for a given jurisdiction.

Though the stated variables may not directly influence the economies of scale equation, they do influence budgetary and financial considerations within each fire department organization. Moreover, each fire department may have different insurance plans, retirement plans, and labor contracts. Trying to equalize the aforementioned variables over several fire department agencies becomes a difficult task for all parties involved; specifically, organizations having multiple taxing structures, varying demographics, and different governing boards (e.g., city commissioners, county commissioners, and Board of Fire commissioners).

Despite the aforementioned limitations, the research has implications for the study of technical and allocative efficiencies within the emergency services arena. The embedded quantitative and qualitative analyses used in this study provided the researcher with a template for advising policymakers on particular emergency service cost drivers influencing a given organizational design, while uncovering themes related to service provisions not captured in a statistical equation. Melding public choice theory and various strands thereof with institutional collective action constructs is as dynamic as the

chaotic nature of protecting the homeland. The ability to model cost equations statistically while simultaneously uncovering service provision narratives provides a comprehensive approach to advancing how the practitioner can protect and secure the homeland from natural and man-made threats.

In protecting the homeland from natural and man-made disasters, elected officials and practitioners must understand that many parts make the whole in emergency preparedness. One component of the emergency preparedness equation addressed in this research was the fire service organizational design.

Centralize or Decentralize Fire Services?

The current study's main thesis of unearthing the most preferred fire service organizational design to protect the homeland is paramount in protecting future generations. As uncovered during this study, crafting shared service agreements that make a difference requires delving into the public safety agency budgets and comprehensive annual financial reports while simultaneously interviewing the decision makers responsible for developing and implementing the ISAs. To understand when economies of scale exist it is paramount to utilize multiple linear regression techniques using predictor variables such as emergency service calls, apparatus, population, cost per capita, cost per square mile, and fire stations for all agencies involved in the ISA process.

Understanding which agency best provides a given service requires interviewing department heads to ascertain what services currently are provided, what services are needed, and what is the agreed upon resource level. As revealed during this study, the various fire departments provided unique service resources that were made available county-wide; therefore, duplication of service efforts were minimized while maximizing

response capabilities for first responders and the community. Lastly, to grasp what available infrastructure is in place to service multiple communities requires delving into current and future capital budget requests and interviewing agency directors to determine a current and future resource inventory list. Then, using a causal integrated network variable list, the analyst can develop a design-event state network to aid in decision-making processes.

Using the causal model as developed in this study, elected officials and agency directors across the United States have a template for assessing if consolidation or centralization of like fire agencies is the appropriate organizational design. Or whether a polycentric, decentralized county is the appropriate design for producing and providing fire service response.

The answer to which organizational design is the most appropriate to provide fire service in a given community was not this study's main thesis; rather, it serves as an inquiry into what scholarly tools are available for stakeholders (specifically at the local levels) interested in solving this complex policy issue. The scholarly tools, as shown in this research, include statistical regression modeling, coupled with interviewing fire chiefs. Protecting the homeland is a national concern, but the greater responsibility falls on local communities' budgets and first responders to mitigate all emergency types. As such, it is imperative to learn from the experts and incorporate their knowledge with scientific analysis.

The emergency services landscape in the United States requires counties and cities to provide police, emergency medical services, and fire departments to their communities while balancing the overall budget to maintain appropriate safety levels

within their respective communities. In doing so, as discussed in this research, requires government agencies to contemplate their administrative structures (i.e., hierarchical chains) in terms of scale and response capabilities. It requires viewing the local emergency response situations in terms of a collective action problem, which shifts the research dynamic to a governance arrangement dilemma.

The current study begins to address what administrative structure in terms of scale and response capability is most appropriate for a given community. This study analyzed a centralized county fire department enveloped within a decentralized city and ISFCD fire agency. The county fire agencies studied may not provide emergency services at the lowest possible cost or produce scale economies based on annual emergency service calls; instead, they are providing emergency services under three different administrative structures with a penchant for achieving allocative efficiency measures. The county fire agencies are competing simultaneously with each other to provide their highest service level, while collectively working together through voluntary established ISAs to protect the entire community. This centralized-decentralized structure works well for the community studied, but it may not be the answer for other similar counties.

Recommendations for Future Research

Interlocal service agreements are a vital component of local government's strategy to produce and provide services throughout its metropolitan governance system. In the American fragmented governance systems, ISAs allow public sector entities to share personnel and resources in an effort to decrease costs and take advantage of economies of scale in the production and provision of public services. Moreover, the

agreements defining ISAs, as discussed in this research, produce intangible benefits of trust and service professionalism over time.

For those advocates who do not favor a fragmented governance structure, the answer may be a comprehensive consolidation approach that may reduce service duplication, diminish government competition while achieving particular economies of scale. One issue affecting certain communities from approaching a consolidated solution to fire services is the assertion that some communities reject perceived efficiencies when the targeted service affects a particular community identity. As identified in this research, the city and ISFCD have a solid community identity and the fire departments work very hard to maintain their identity through public education and community service budget appropriations.

The city fire department places great emphasis on community outreach education programs that span all ages and demographics. The emphasis stems from the elected officials through the city manager down to all divisions. The city organizational culture of giving back to its community is shown in the authorized fire department budget expenditures for community education and outreach programs. As shown in Figure 57 the city is annually allocating on average 3% more to support the community education outreach programs over FY 2011-2015.

Using in-service/on-duty crews and volunteers, the city fire department provides a plethora of community outreach programs to its citizenry and to all residents within the county. Some of the highlighted community outreach programs the city provides include, but are not limited to: (a) a household sharps disposal and operation medicine cabinet, (b) special needs program for oxygen deficient citizens, (c) smoke detector

battery replacement program, (d) fire extinguisher training, (e) child car seat program, and (f) CPR courses and certification classes.

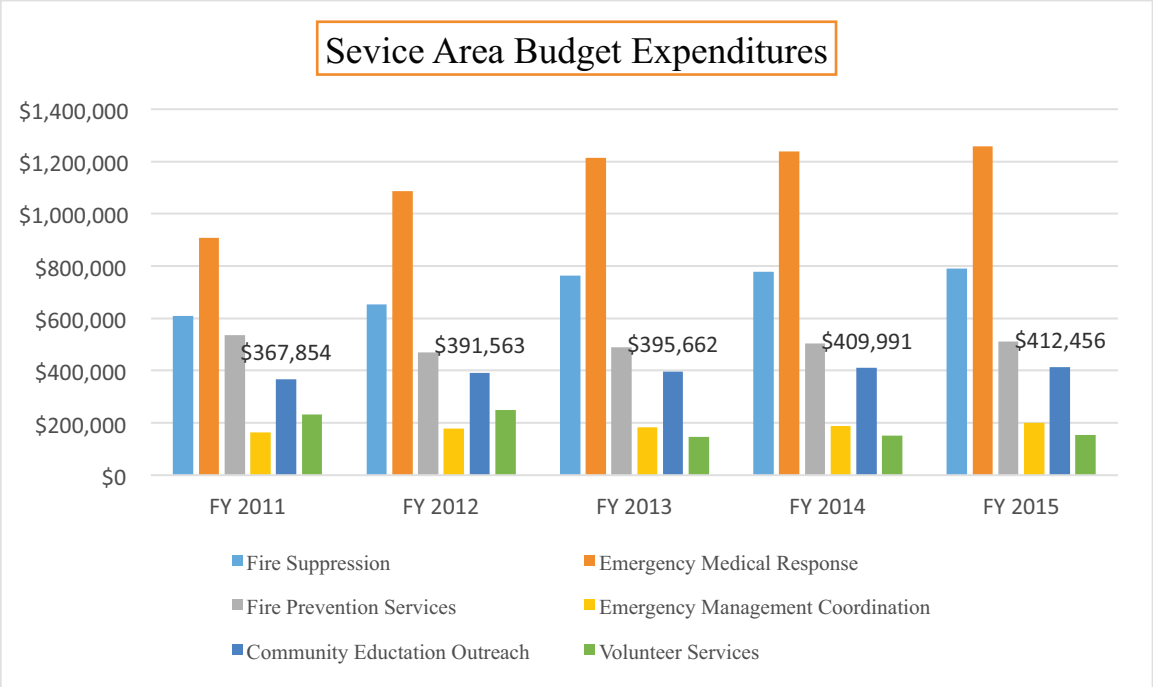


Figure 57. City Fire Department Service Area Annual Budget Expenditures FY 2011-2015.

To combat the centralized versus decentralized fire service dichotomy, further research requires revisiting the new public service mantra of solving relevant public administration issues by creating opportunities for citizen engagement, and working with citizens to define public problems, develop alternative scenarios, and implement solutions. Future research requires inquiring deeper into the ISFCD and city fire departments' outreach surveys and programs and beginning the consolidation conversation with the citizens.

Adding to the literature base on a centralized versus decentralized fire service organization design requires future research to fuse the citizen ethos with the fire service

literature, as presented in this study, to create a holistic approach to solving some of the most complex public challenges. Engaging and speaking with the individual community members regarding appropriate fire service response levels, public safety needs, and interest in consolidation adds scholarly depth not displayed in this research. Moreover, incorporating the citizenry's responses into the fire service equation addresses additional empirical analyses, while adding a democratic ethos based on personal values. Combining the scientific with normative moves the centralization and decentralization fire service/emergency response dialogue into the future.

Concluding Remarks

The public choice vision needed to solve the fire service centralization versus decentralization argument requires human communities solving more than statistical modeling based on an abundance of budgetary facts and individualistic preferences; rather, a common language is needed within a community of shared knowledge and understanding that moves this conversation forward. The articulation of a fire service language helps develop a culture of inquiry premised on choices, thus enabling all stakeholders to identify and resolve problematic situations. This human community is the future of public choice, and it requires market forces resting on pillars of scientific inquiry and citizen engagement.

The purpose of this study was to begin the future of that public choice and to develop a common framework, an inquiry of language knowledge based on economic and human information designed to advance the fire service community. The need and timing of this study to advance choices cannot be understated as the world has endured an inordinate number of mass shootings and terrorist activities during 2015. According to a

USA Today report titled *Behind the Bloodshed: The Untold Story of America's Mass Killings* (2013), 29 mass shootings within the United States have taken 155 lives during the 2015 calendar year. Protecting the homeland, moreover the world, requires not only scholar and practitioner expertise, but business leaders, elected officials, community organizations, and citizenry working under a common language to ensure children have the same opportunities adults enjoy. Protecting the homeland requires not making choices based on a lack of knowledge but, instead, on multiple diverse communities working in unison so intelligent and rational decisions move the conversation.

APPENDICES

Appendix A. Survey Instrument

Hello. My name is Salvatore A. D'Angelo III and I am a Doctoral Candidate at Florida Atlantic University. The following survey instrument allows me the opportunity to ascertain pertinent information with respect to fire service organization design(s) within the county. The intent is to develop broader themes for fire service professionals and policymakers to use in developing relevant emergency service policy. Thank you for assisting me in this research endeavor.

I. **Introductory Section**

1. What is your Official Title and Rank?
2. How long have you served in your current rank?
3. How many years have you been in the Fire Service?
4. How long have you been employed with the current agency?
5. Are you a member of the trade organization(s) within the State of Florida (e.g., Florida Fire Chiefs Association)? If so, which organization(s)?

   5b. If so, is networking within these trade organizations helpful in your daily operations? Please explain.

II. **Organizational Features**

1. What organizational design is your fire agency?

   A. County Fire/Emergency Medical Services (EMS) – Transport or Non-Transport

   B. Municipality Fire/EMS – Transport or Non-Transport

   C. Independent Fire District providing Emergency Medical Services – Transport or Non-Transport

D. Other

2. What type of governing body oversees your agency?

A. County Commission

B. City Commission

C. Board of Fire Commission

D. Other

3. Does your organization follow the National Fire Protection Association (NFPA) 1710 standard with respect to staffing levels for first-due fire or EMS service call assignments?

4. Is your organization a paid career fire department? A combination paid/volunteer fire department?

5. Does your organization follow a strict authoritarian/hierarchical chain-of-command?

5b. If not, what type of hierarchy best describes your organizational type?

6. How many rank classifications are between you and the front-line supervisory rank? (e.g., levels of command between you and a shift Battalion Chief)

7. How many personnel are included in the answer to question five?

8. How many rank classifications are between the front-line supervisory rank and the Fire Fighter classification?

9. How many functional divisions are under your command? (e.g., Fire Operations, EMS, Fire Prevention, Support Services, Finance, Human Resources, and Fleet)

10. Do you employ civilian personnel to lead or manage your functional divisions?

10b. If so, which divisions? Why employ civilian versus sworn uniformed personnel in said divisions?

11. Do you employ part-time personnel in any of your divisions?

11b. If so, what divisions?

11c. If not, why?

12. Does your organization have a labor union? If so, what is the participation rate within the labor union?

III. **Organization Size and Services Offered**

1. What is the size in square miles of your jurisdictional boundaries?
2. How many sworn uniformed personnel as described in Florida State Statue 633 does your organization employ?
3. How many of the sworn personnel hold the Chief Officer rank?
4. How many calls for service, as reported in the 2014 National Fire Incident Reporting System (NIFRS) does your organization respond to?
5. What services are offered by your organization (e.g., fire suppression, hazardous materials, boat operations, EMS, fire prevention, trench rescue, etc.)?
6. How many fire stations are within your jurisdictional boundaries?
7. How many first-due fire apparatuses are within your jurisdictional boundaries?
8. How many ambulance (i.e., Advanced Life Support) transport units are within your jurisdictional boundaries?

8b. Does your organization own or lease the ALS units?

8c. If not, how are the ALS units supplied in your jurisdictional boundaries?

9. Does your organization take part in any Mutual Aid agreements?
10. Does your organization take part in any Automatic Aid agreements?
11. What is the ratio of mutual aid given versus received?

12. What is the ratio automatic aid given versus received?

13. What is your total fiscal year ending 2014 operating and personnel costs?

14. Does your organization have a citizen satisfaction survey for services offered?

IV. **Interlocal Service Agreement(s)**

1. Does your organization use Interlocal Service Agreement(s) (e.g., Mutual Aid and/or Automatic Aid agreements)? Please discuss?
2. Are the ISA's codified in a formal agreement (e.g., Ordinance or Resolution)?
3. How did these agreements come to fruition? Voluntary? Compulsory?
4. Do the ISA's provide a cost savings to the organization?
5. Are there any cost reimbursement components to the ISA?
6. Do the ISA's provide an increased service level to the community?
7. Do ISA's develop trust among the county fire agencies?
8. Do ISA's provide for open or closed communication channels among the county fire agencies?
9. In addition to what has already been discussed, what else do you feel is an important component of the ISA?

Appendix B. IRB Approval

Institutional Review Board
Division of Research
777 Glades Rd.
Boca Raton, FL 33431
Tel: 561.297.0777
fau.edu/research/researchint

Michael Whitehurst, Ed.D., Chair

DATE:	July 27, 2015
TO:	Khi Thai, Ph.D.
FROM:	Florida Atlantic University Social, Behavioral and Educational Research IRB
PROTOCOL #:	736502-1
PROTOCOL TITLE:	[736502-1] An Inquiry Into Fire Service Consolidation and the Economies of Scale Debate: The Centralization versus Decentralization Argument
SUBMISSION TYPE:	New Project
REVIEW CATEGORY:	Exemption category # *A1*
ACTION:	DETERMINATION OF EXEMPT STATUS
EFFECTIVE DATE:	July 27, 2015

Thank you for your submission of New Project materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has determined this project is EXEMPT FROM FEDERAL REGULATIONS. Therefore, you may initiate your research study.

We will keep a copy of this correspondence on file in our office. Please keep the IRB informed of any substantive change in your procedures, so that the exemption status may be re-evaluated if needed. Substantive changes are changes that are not minor and may result in increased risk or burden or decreased benefits to participants. Please also inform our office if you encounter any problem involving human subjects while conducting your research.

If you have any questions or comments about this correspondence, please contact Tina Horton at:

Institutional Review Board
Research Integrity/Division of Research
Florida Atlantic University
Boca Raton, FL 33431
Phone: 561-297-0777
researchintegrity@fau.edu

* Please include your protocol number and title in all correspondence with this office.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within our records.

Appendix C. Adult Consent Form

ADULT CONSENT FORM

1) Title of Research Study: An Inquiry Into Fire Service Consolidation and the Economies of Scale Debate: The Centralization versus Decentralization Argument

2) Investigator(s): Dr. Khi Thai, Principal Investigator (PI) and Salvatore A. D'Angelo III (Study Personnel)

3) Purpose: The purpose of this research endeavor explores the economies of scale debate among different fire service organization types

4) Procedures:

- You will sit for an interview with myself – I will have 30 questions that need a response
- Your time commitment is 2 hours maximum for one session
- The interview is recorded for note taking accuracy and data recording
- Interview sessions take place at an office of your choosing

5) Risks: There are no foreseeable risks with taking part in the research survey.

6) Benefits: The benefit to your political jurisdiction, once the research is complete, is a decision-making tool that offers practitioners and politicians a guide for designing a fire service organization that meets the challenges of the post-911 environment. This research contributes to a greater understanding of fire service provision from a regional and fragmented perspective, then, generalize which model best serves a given community.

7) Data Collection & Storage:

Any information collected about you will be kept confidential and secure and only the people working with the study will see your data, unless required by law. The data will be kept for 3 years in a locked cabinet [or password-protected computer] in the investigator's office. After 3 years, paper copies will be destroyed by shredding and electronic data will be deleted. We may publish what we learn from this study. If we do, we will not let anyone know your name/identity unless you give us permission.

8) Contact Information:

- If you have questions about the study, you should call or email the principal investigator(s), Sal D'Angelo at 561-297-0443 or sdangel@fau.edu. For further questions please contact the faculty advisor overseeing said research, Dr. Khi Thai at 561-297-0443 or kthai@fau.edu.
- If you have questions or concerns about your rights as a research participant, contact the Florida Atlantic University Division of Research at (561) 297-0777 or send an email to fau.research@fau.edu.

9) Consent Statement:

*I have read or had read to me the preceding information describing this study. All my questions have been answered to my satisfaction. I am 18 years of age or older and freely consent to participate. I understand that I am free to withdraw from the study at any time without penalty. I have received a copy of this consent form.

I agree ____ I do not agree ___ be audiotaped/videotaped.

Signature of Participant:_____ Date: _____

Printed Name of Participant: First Name _____ Last Name_____

Signature of Investigator: _____ Date: _____

FAU Institutional Review Board

Approved on:	7/27/2015
Expires on:	Exempt

Appendix D. Verbal Script

Hello. I am Salvatore A. D'Angelo III, from Florida Atlantic University, Department of Public Administration. I am working on my dissertation and the research study includes various fire department organizational designs in an effort to understand economies of scale. The benefits to participants and policy planners rests in the ability to discuss what fire department predictor variables influence, or not, scale economies.

Today you will be participating in an informal interview which should take approximately 60 to 90 minutes. Your participation is voluntary. If you do not wish to participate, you may stop at any time. Responses will be confidential, and remain anonymous. Your name will not appear anywhere in the dissertation, and all recordings, if any, are stored in a locked cabinet for three years. There are minimal risks associated with this research. Taking part in this research is your agreement to participate.

If you would like a copy of this letter for your records, please let me know and I will give you a copy now through mail, email, or fax. If you have any questions regarding the research, contact Dr. Khi Thai at Florida Atlantic University, Director of Public Administration - (561) 297-2330. If you have any questions regarding your rights as a research subject, please contact the Florida Atlantic University Division of Research at (561) 297-0777. Thank you again for your help.

Appendix E. Sample Customer Survey

[redacted]

[redacted]

Customer Service Satisfaction Survey

		Outstanding	Excellent	Average	Fair	Poor
1.	The 9-1-1 call was handled in a prompt, courteous and competent manner:	●	O	O	O	O
2.	The firefighters' response time to my emergency was prompt:	●	O	O	O	O
3.	The firefighters' actions helped reduce property damage, resolved the situation, or made the situation safer:	●	O	O	O	O
4.	The firefighters' acted in a concerned, caring and professional manner:	●	O	O	O	O
5.	The firefighters' took actions or provided customer service beyond my expectations:	●	O	O	O	O
6.	The assistance provided to me by the Officers' and firefighters; during and after my emergency was:	●	O	O	O	O
7.	Rate the overall experience with the Fire Department and the services provided:	●	O	O	O	O

		Yes	No
1.	Do you have smoke alarms in your home or business?	●	O
2.	Did your smoke alarm alert you of the fire?	O	● NA
3.	Was 9-1-1 called immediately upon discovering of the fire?	O	O NA
4.	Would you like your Fire Department to conduct a safety fire inspection of your home or business?	O	●
5.	Would you be interested in learning more about fire safety in your home or business?	O	●

Do you have any suggestions about how we could improve our services to you? _____

_____

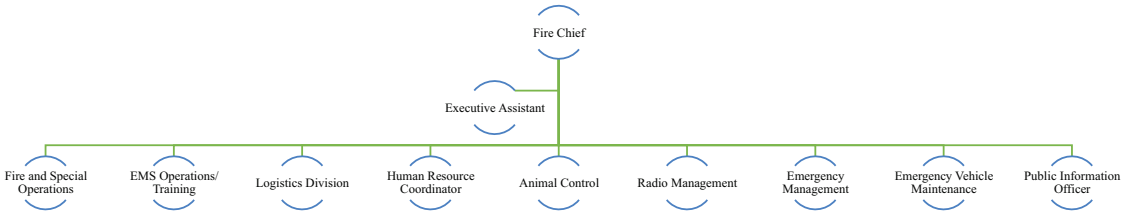
_____

_____

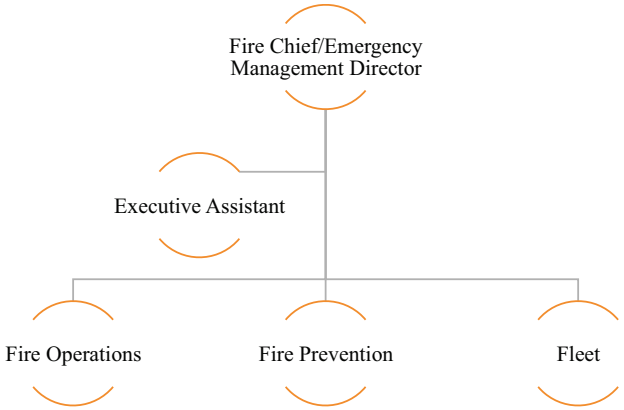
Alarm#: _____ Date:_____ Situation: _____ Station#: _____ Shift: _____

Appendix F. Fire Departments' Span of Control

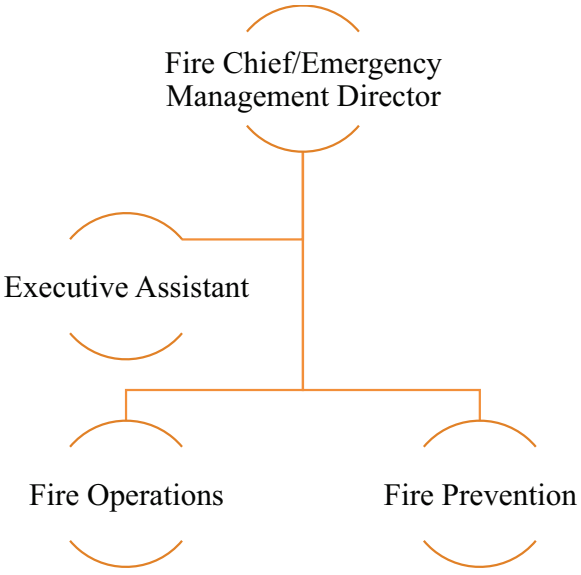
FIRE CHIEF SPAN OF CONTROL AND LINES OF AUTHORITY



CITY FIRE CHIEF SPAN OF CONTROL AND LINES OF AUTHORITY



ISFCD FIRE CHIEF SPAN OF CONTROL AND LINES OF AUTHORITY



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