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Assessment of Public Safety Technology

Planning and Implementation in Mesa

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The fire service is being transformed by a continuous evolution of technology that is affecting daily operations at a fundamental level. Mesa has been implementing proven cutting-edge information and communication technologies (ICT) in an effort to improve efficiency and streamline business processes. Emerging technologies, such as the nationwide public safety broadband network, have the potential to vastly improve the safety and overall effectiveness of fire personnel by providing access to real-time data. The need for effective strategic planning and implementation of technology has never been more important. But, strategic planning is encumbered without a full understanding of where ICT and the fire department are now and where they are heading.

The problem is that the Mesa Fire and Medical Department has not done an internal review of its current ICT investments or the process by which it conceptualizes, develops, and implements technology. The purpose of this applied research project is to describe the current state of public safety ICT implementation in Mesa and to identify the most problematic issues in the implementation process. Descriptive research techniques were employed to answer the following questions: (a) how well do existing technologies meet the needs of end-users, (b) do the current ICT support systems ensure the effective implementation of new technologies, and (c) is there an adequate planning and research process in place for developing emerging technologies to meet the future ICT needs of the fire department? The results indicate that most stakeholders do not feel technology is currently implemented to its full potential. Recommendations are made to involve end-users in ICT strategic planning efforts, adopt a formal research and development process, and upgrading several existing systems.

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Introduction

A key priority for the City of Mesa is to ensure that first responders are provided the best technology the City can afford so that they can carry out critical public safety operations. The Mesa Fire and Medical Department (MFMD) prides itself on utilizing proven cutting-edge information and communication technology (ICT) in support of its mission. For example, the MFMD was an early adopter of an electronic patient care reporting (ePCR) system, which enables electronic sharing of patient information between fire department paramedics, hospitals, and transportation providers (Raines, 2010). The Department also implemented a video conferencing system for real-time in-service delivery of quarterly training and virtual face-to-face communications (Raines, 2009). Over the past few years, Mesa has undertaken a sweeping overhaul of its financial system that will impact departments citywide. The project, known as CityEdge, has already begun to revamp software that affects the way the MFMD conducts budgeting, grant administration, payroll, and human resources (Wipf, n.d.).

Information systems and communications technologies are among the most significant capital investments that agencies can make (U.S. Department of Homeland Security [DHS], 2008). Yet, organizations risk new technologies being improperly used or rejected without an understanding of the business processes, workflows, and cultures that need to be attuned for the technology to be accepted by end-users (Washko, 2013). Recognizing the need for an overarching public safety ICT strategy to address these issues, the Mesa City Council directed the City Manager's Office to work with the City's police and fire departments and the Information Technology Department (City ITD) to develop a Public Safety ICT Strategic Plan that would facilitate continued delivery of

timely, high-quality ICT services to public safety departments and participating partner jurisdictions, address emerging demands for public safety ICT support, and achieve greater operational efficiencies and cost savings in budgeting. Ideally, the Public Safety ICT Strategic Plan would effectively integrate with a broader citywide ICT roadmap to ensure economies of scale and operational linkages where appropriate.

Strategic planning for technology is greatly encumbered without a full understanding of where ICT and the fire department are now and where they are heading. City ITD has incorporated some planned application upgrades into its 5-year technology roadmap to support major public safety systems, such as Computer Aided Dispatch (CAD). But, the lack of a formal public safety ICT strategy impacts the MFMD's and the City's ability to adequately plan and budget for technology upgrades needed in coming years. The funding for this technology and its impact on staff, process, services, and long-term maintenance are not identified until the need for technology is immediate. Consequently, far too many public safety technology purchases are funded out of the operations and maintenance (O&M) funds, which have proven to be insufficient in meeting pubic safety technology needs. Ultimately, the technology strategy should reflect the everyday needs of the public safety end-user.

The problem is that MFMD has not done an internal review of its current ICT investments or the process by which it conceptualizes, prioritizes, and implements public safety ICT technology. The purpose of this applied research project to describe the current state of public safety ICT implementation and to identify the most problematic issues in the implementation process. While the project focused on fire department technology needs, the City ITD, the Mesa Police Department, and MFMD partner

jurisdictions were included where interoperability issues and shared technologies were concerned. This project was completed as part of the National Fire Academy Executive Fire Officer Program course R306: Executive Analysis of Fire Service Operations in Emergency Management. Descriptive research techniques were used to answer the following questions: (a) how well do existing technologies meet the needs of the fire department end-user, (b) does the City's current ICT support system ensure effective implementation of new public safety technologies, and (c) is there an adequate planning and research process in place for developing emerging technologies to meet the future ICT needs of the fire department?

Background and Significance

The City of Mesa Information Technology Department (City ITD) provides overall technology leadership, system implementation and ongoing support for broad range of technologies used by city departments to serve constituents, including radio, telephone and computer networks. Technology services provided by City ITD include business solutions and support, infrastructure development, and enterprise services. City ITD also manages the City's central data center, which houses most of the computer servers and storage platforms used by City departments, and directs the development of certain computer application projects on behalf of other departments, including public safety departments. The City of Mesa has received numerous awards for its technology policies and innovations. In 2013, Mesa was selected as the seventh best large digital city according to a survey conducted by the Center for Digital Government (Nelson, 2013a). Mesa has also received several awards from the Public Technology Institute for

technology solutions in public safety and emergency management ("2012-2013 technology solutions awards," 2013).

As Mesa has grown, the structure for the delivery of public safety ICT services has evolved from a centralized model, where City ITD provided all technology-related services, to a hybrid model, where public safety ICT services are provided by a combination of City ITD, the Mesa Police Information Technology Section (PD ITS), and MFMD Technical Services (FD TS). City ITD provides enterprise-level services and support to both the police and fire departments. City ITD also provides business application support and some project management support to the MFMD. The FD TS organization has limited functional responsibilities. PD ITS has a separate structure that supports all police operations and manages the CAD and mobile system that is shared with the fire department and its partner jurisdictions.

City ITD supports all public safety enterprise solutions, such as e-mail, Internet, City Edge, and general telephony, among others. There are few City ITD staff members that routinely support fire applications, and several others who provide project management and network support services for the MFMD. City ITD also provides backup desktop support to the fire department, and to the MPD when requested. The department provides no ICT support services to the MPD on an on-going basis other than the enterprise services previously noted. The concern is that this fragmented support system might negatively affect implementation.

The MFMD has two areas supporting its public safety ICT operations. The FD TS organization is comprised of approximately 10 staff members and provides a broad array of IT support services to end-users, including desktop and software support to staff and

mobile data terminal (MDT) support for equipment installed in various fire apparatus. FD TS is the first line of support for all ICT services required at fire stations. The department has two Geographic Information Systems (GIS) technicians that maintain and update the GIS maps used in Computer Aided Dispatch (CAD) and MDTs for both the fire and police departments. They are responsible for creating and updating pre-plan maps and plat maps used in incident response. The Fire Dispatch area has one technical staff member who supports CAD operations. A Deputy Chief acts as liaison between the MFMD and MPD to ensure radio communications and emergency dispatch meet the needs of the fire department, as well as to provide research, development, and implementation of new technologies. Mesa is also the Administrative Manager of the Topaz Regional Wireless Cooperative (TRWC). The function of the TRWC is to promote interoperable communications through joint operation of a regional radio system.

The MPD operates two sections supporting its public safety ICT functions: PD ITS and the Public Safety Communications Division. The PD ITS is comprised of approximately 35 staff members. They provide project management, desktop and laptop computer support, MDT support for all police vehicles, network design and support, information security, CAD support, and police application support to all police officers and staff. The Public Safety Communications Division has two additional staff members who support the City's 9-1-1 telephony services.

One outcome of this fragmented public safety ICT structure is that City ITD and the public safety agencies lack communication and coordination on technology initiatives. This fosters an ad hoc approach to project identification, prioritization, and development. The service delivery model for the MFMD is particularly complicated

because FD TS, PD ITS, and City ITD are all responsible for delivering aspects of ICT service to fire department end-users. Consequently, inefficiencies exist in the system that may negatively affect how well technology is implemented in the MFMD.

This applied research project is significant to the MFMD in that it addresses the department's *Strategic Plan 2006* initiative to "[e]nhance current and future technologies to improve services for internal and external customers, to minimize costs, and to provide efficient and effective services" (p. 30). A key goal under this initiative is to develop a technology strategic plan that integrates with citywide systems and addresses the needs of regional partners. "Communications investments are among the most significant, substantial, and long-lasting capital investments that agencies can make; in addition, technological innovations for emergency communications are constantly evolving at a rapid pace" (DHS, 2008, p. ES-2). Indeed, the City of Mesa has made substantial investments in public safety ICT over the past few years. The 2008 Capital Improvement Program (CIP) included $8.6 million for emergency communications projects including hardware and software upgrades to the 800 MHz trunked radio system. Public safety bonds passed by voters in 2013 provided an additional $4.6 million to invest in fiber-to-radio network backbone sites that will provide improve reliability and increase bandwidth for voice and data communications to fire department facilities. However, the Department's record of obtaining continuous funding for ICT-related infrastructure has lacked consistency. In order to generate a higher level of confidence for future funding, the MFMD must provide a clear business case supported by a robust ICT strategy.

This research project is related to the National Fire Academy (NFA) Executive Analysis of Fire Service Operations in Emergency Management course, which recognizes

that "[c]ommunications is the lifeblood of any organization" (U.S. Fire Administration [USFA], 2012, p. SM 5-17) and that interoperability of both voice and data systems continues to be a challenge for first responders. As stated in the student manual:

> In the past, strategic planning has been fragmented. Few departmental heads had a vision for interagency communication. Newer digital communications systems often lack an ability to "connect" to other disciplines because of proprietary software while aging and incompatible communication infrastructure increases maintenance cost and reduces reliability. (p. SM 5-19)

Complicating efforts to improve interoperability is that some agencies have been "reluctant to give up control over their communications systems and regulations causing conflict with other jurisdictions" (p. SM 5-10). Phoenix and Mesa formed two public safety radio cooperatives in 2008 after they could not come to terms over governance and control of what was supposed to be a single regional radio network (Nelson, 2013b; Topaz Regional Wireless Cooperative [TRWC], 2008). While the two cooperatives are moving, once again, towards a unified radio system (Nelson, 2013c), lingering interoperability issues are likely to remain without ultimately creating an ITC strategic plan that reflects the everyday needs of pubic safety end users.

Finally, this research addresses the U.S. Fire Administration's (2010) strategic initiative for emergency preparedness which seeks to ". . . enhance capabilities, interoperability and deployment strategies for response to natural disasters" (p. 16). The use of technology has broad applications for achieving many of the goals set forth in the USFA's strategic plan. For example, ePCR and GIS databases are being used to improve local planning and preparedness by expanding "the use of modern data and information

analysis in planning and preparedness" (USFA, 2010, p. 19). Social media tools and mobile applications (apps) are increasingly being used to reduce risk at the local level through public education, marketing, and customer service initiatives. Mesa has already released a police mobile app that provides citizens accesses to alerts and crime information (Connelly, 2013) and the MyMesa app allows users to report problems such as graffiti, potholes, missed garbage, and a number of other common issues that may need attention (Polletta, 2013). And, the MFMD's video conferencing system is enhancing the professional status of the fire department by providing a distance learning solution for in-service training and professional development.

Literature Review

How public safety agencies access and disseminate information and how they manage the technologies associated with it are becoming increasingly critical. A literature review was conducted as part of this applied research project to accumulate background information on ICT strategic planning and implementation. The literature review contained herein provides an overview of what has been published by scholars, researchers, and technologists on the topic. Using the Arizona State University (ASU) Library "One Search" Web portal, databases were searched using the key words *information technology strategic planning, strategic information systems planning*, *SISP, information systems plan*, *information technology plan*, and *technology implementation*, combined with *fire department* and *public safety*. Additional sources of information included academic journals, as well as professional and trade magazines, books, government and non-governmental organization (NGO) publications, position papers, newspaper articles, and Internet sites. The following review covers different areas that are

integral to understanding the prevalent issues surrounding ICT in the public safety domain, as well as ICT strategic planning in the public sector, and the process of implementation of technology in organizations.

ICT in the Public Safety Domain

The use of information technologies has expanded dramatically over the past decade and changed the way people access and share information. Government has applied new ICT to "support improvements in productivity, management effectiveness and ultimately, the quality of services offered to citizens" (Gichoya, 2005, p. 175). Known as e-government (short for electronic government), it "refers to a government's use of information technology to exchange information and services with citizens, businesses, and other arms of government" (Kumar & Sinha, 2007, p. 294). According to Moon (2002) the focus of e-government shifted with the introduction and evolution of mobile technologies toward m-government (short for mobile government) that seeks to "provide information and services . . . through wireless communication networks and mobile devices such as pagers, PDAs, cellular phones, and their supporting systems" (p. 4). The introduction of smartphones and tablet computers has provided an additional impetus for government to change the way it communicates and conducts business.

Mobile devices are also providing a platform for emergency responders and the public to communicate and manage public safety concerns. In a paper for the Center for Technology Innovation at Brookings, West and Valentini (2013) identify mobile devices and applications that are transforming disaster relief and public safety. In December 2012, the London Fire Brigade became the first fire agency to experiment with social media as a means of public access to emergency services by launching a 999 emergency

Twitter feed as a supplement to the existing telephone system (London Fire Brigade, 2012). Santiago, Chile pilot tested a low-cost groupware application that allowed firefighters to communicate through Wi-Fi, cellular, or an ad hoc network to overcome communications problems due to a lack of telecommunications infrastructure. The app enables exchanging of graphical and textual information using mobile devices and greatly reduced firefighter arrival time (Monares et al., 2011). A North Carolina firefighter – and self-taught computer programmer – is creating an app for Google Glass that will provide information such as routing, building blueprints and hazards, as well as use the device's camera to record, transmit and receive data (Jerrard, 2014; Kelly, 2014). A survey conducted by International Association of Fire Chiefs (IAFC) found that the use of smart phones, tablets, and other mobile devices among U.S. fire departments was becoming more prevalent noting that this has "implications for incident command, training and operations, and communications within the department and with the public" (IAFC, 2011, para. 11).

Unfortunately, many innovative ICT concepts and technologies are not readily applicable to the public safety. Although public safety agencies regularly use commercially available wireless devices as secondary platforms for communications during operations, these systems are not sufficiently suited for mission critical voice or data communications (National Public Safety Telecommunications Council [NPSTC], 2013). There are major concerns related to security, priority access, and responsiveness, robustness, and reliability. In addition, new ICT technologies are not driven by free-market factors as in the commercial sector, but it is based non-business factors such as political support, budget availability, regulations, and public attention and concern for the

issue. Public safety is considered a niche market compared to the larger commercial telecommunications market (USFA, 2008) with specialized hardware and slow evolution.

Baldini, Sallent, Subik, and Wietfeld (2011) identified four significant challenges for ICT operating in the public safety domain: interoperability, broadband connectivity, challenging operational environment, and equipment lifecycle.

Interoperability. The 9/11 Commission Report identified interoperability as a limiting factor in the effectiveness of emergency operations (National Commission on Terrorist Attacks upon the United States, 2004). Since then, improving interoperability has been a major focus of public safety organizations nationally (Pessemier, 2005). SAFECOM defines interoperability as "the ability of public safety and support providers – law enforcement, firefighters, EMS, emergency management, public utilities, transportation, health, medical and others – to exchange voice and data communications on demand, in real time and when authorized" (Pessemier, 2005, p. 3). Interoperability is important because information sharing is critical to informed decision-making and coordinated operations. Barriers to effective interoperable communications cited in the literature include operational differences among response agencies; a lack of regional cooperation between jurisdictions; technical incompatibility of networks, systems, and devices; and limited financial and other resources (DHS, 2008; National Governor's Association [NGA], 2009; USFA, 2008; Pessemier, 2005). While the Nation and public safety community has made great strides in addressing this issue, there remains significant work to be done toward truly interoperable communications systems. New initiatives, such as the nationwide public safety broadband network (NPSBN), promise to improve communications, but also pose challenges of their own.

Broadband connectivity. Mobile technologies in the public safety domain are driving the demand for transmitting large data files including real-time video, digital photographs, mapping software, access to external databases, and a host of applications brought directly to the field (Nibarger & Teubner, 2012). Current narrowband communications systems provide only limited data capability. With passage of the Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96), Congress assigned the "D Block" spectrum – a 10 Megahertz (MHz) section of radio spectrum next to the 10MHz currently used by public safety – and provided $7 million for the planning, building, and managing of a nationwide broadband network for public safety (Moore, 2014). The NPSBN is required to be based on commercial standards for Long Term Evolution (LTE) "to keep pace with changed in technology and leverage cost efficiencies" (DHS, 2011, p. 1). However, since the technology standard proposed for the broadband network will not provide an immediate replacement for the current land mobile radio (LMR) system for mission-critical voice, communities must continue to make investments in upgrades to their LMR systems. Ultimately, the NPSBN is intended to replace the current communications patchwork used by state and local first responders and federal disaster response teams, leading to greater interoperability and coordination, and better information provided to the field.

The network is still in the initial planning stages meaning a fair amount of uncertainty remains about the implications for state and local governments (The National Association of State Budget Officers, 2013). According to a report to Congress by the U.S. Government Accountability Office (GAO, 2012) challenges to implementing the NPSBN include ensuring the network's interoperability, reliability, and security;

obtaining adequate funding to construct and maintain it; and creating an appropriate governance structure. Participants in the Roundtable Series on Entrepreneurship, Innovation, and Public Policy held at the University of Colorado Law School in Boulder, Colorado discussed public safety communications and several significant near-term challenges in creating a NPSBN including creating a workable governance strategy, the limited ability of LTE to support mission-critical simplex voice communications, and the lack of sufficient funding (Cook, 2012). However, the panel also emphasized the many benefits the NPSBN would bring to first responders in comparison to the current commercial broadband market.

Challenging operational environment. Public safety operations present a challenging operational environment for technology. First responders are dependent upon fast, reliable communications in order to improve situational awareness and coordinate response activities (Baldini et al., 2011; NGA, 2009). Typically, communications capacity demands for public safety are fairly modest, but are subject to spikes during large incidents. "During the last three decades, the Nation has witnessed how inadequate emergency communications capabilities can adversely affect response and recovery efforts" (DHS, 2008, p. 1). During disaster, telecommunications infrastructure can be destroyed and cellular networks congested due to a surge in mobile phone use. Both scenarios hamper mission critical public safety communications. Numerous studies and after-action reports have citied communications problems and an inability to coordinate across disciplines or jurisdictions as a major failing in disaster response efforts (DHS, 2014; Pessemier, 2005). Similarly, events such as the Virginia Tech shooting demonstrate

a need for improved communications capabilities to provide timely public information and alerts (Attorney General Roy Cooper Campus Safety Task Force, 2008).

Fire fighting presents a uniquely harsh and hostile environment for ICT that is markedly different that any other communications end-user. In an introduction to the USFA (2008) document, *Voice Radio Communications Guide for the Fire Service*, International Association of Fire Fighters General President Harold Shaitberger wrote:

> Fire fighters must be able to communicate in cold and hot temperature extremes, in wet and humid atmospheres full of combustion byproducts and dust, while under or above ground, inside and below buildings and in rubble piles. Other environmental challenges include loud noise from apparatus, warning devices, tools and the fire itself. Any new radio communications system must take these factors into consideration. (p. ii)

The life safety of both firefighters and citizens depends on dependable, functional communication tools that work reliably under these conditions (p.1).

The IAFC (2005) also identified the unique needs of the fire service when it comes to communications technology. These include portable, hands-free communication capabilities; ruggedized hardware that can operate in sever environments; clearly audible voice communications under noisy conditions; reliable coverage indoors, underground, and in other locations where reception may be difficult; a network with enough channels or talk groups to allow fast deployment on large scale incidents and supports interoperable, multi-jurisdictional communications; and a network that can provide critical data transmission in addition to voice.

Equipment lifecycle. The ICT industry has made the concept of "planned obsolesces" one of the tenants of software and hardware providers (McEwen, 2011) with manufacturers routinely introduce new products to meet the changing needs of the markets they serve (Tait Communications, 2013). According to Baldini et al. (2011):

> A dedicated (public safety) network and related terminals are usually designed and acquired for a long operational time (e.g. 10-15 years), while commercial networks and terminals may be upgraded every 3-4 years or less. A potential risk is that (public safety) technologies may not follow the technical progress of the commercial domain. This is also the consequence of the different market sizes: there are around 1 billion commercial wireless terminals against 5 millions of (public safety) specific terminals. (p. 11)

As the lifecycle of a technology evolves, aging public safety systems will begin to experience deteriorating interface connectivity and agencies can expect increasing costs of maintenance and "support deterioration" as systems become too costly or difficult to update (Jayne, 2012).

Strategic Planning for ICT

From the literature on ICT in the public safety domain it is clear that there will be significant challenges ahead in adapting to m-government initiatives and technology developments in general. According to Gichoya (2005), "ICT needs careful planning and coordination prior to implementation and use otherwise trial and error methods of implementation that characterize most government ICT applications will only succeed in the wastage of scarce resources" (p. 177). Planning ahead for ICT will be a critical step in successful implementation and integration of emerging technologies.

An ICT strategic plan defines the way an agency proposes to manage and enhance its technology assets to support current and future operational needs. Hann and Weber (1996) describe information systems planning as:

> . . . a set of activities directed toward achieving three objectives: (a) recognizing organizational opportunities and problems where (ICT) might be applied successfully; (b) identifying the resources needed to allow (ICT) to be applied successfully to these opportunities and problems; and (c) developing strategies and procedures to allow (ICT) to be applied successfully to these opportunities and problems. (p. 1044)

ICT strategic plans are a tool an agency uses to communicate its technology strategy both internally and externally and for decision-making about future technology investments (NSW Department of Finance and Services, 2011). Any new acquisitions should be evaluated against the ICT strategic plan. Without a strategic plan for ICT, an organization may "merely add up lists of projects, summing resources and buying whatever technology seems to fit each system best and calling it a plan" (Ward, 1995, p. 32). Kramer and King (1977) believe that the "ultimate success or failure of an organization's use of computerized systems can be traced back to decisions made during the planning process" (p. 29).

There appears to be consensus among researchers that organizations must engage in some form of strategic planning for information technology (Kearns, 2006: Newkirk & Lederer, 2007), and that those plans must align with the strategic goals of the organization (Avison, Jones, Powell, & Wilson, 2004; Johnson & Lederer, 2010). The purpose of ICT planning process is to ensure that technology investments are aligned

strategically with the mission and objectives of the organization, as well as with wider community priorities, and to define governance, standards, and policies to ensure that the strategy effectively drives the ICT initiatives being pursued (NSW Department of Finance and Services, 2011). This relationship between ICT strategic planning, agency strategic planning, and community priorities is illustrated in Figure 1. Aligning strategies in this way enables the organization to maximize the impact of its ICT investments (Avison et al., 2004; Yayla & Hu, 2009), ensures compliance with the local government's

Figure 1. Relationship between government, agency, and ICT strategic plans. Source: Adopted from "Information and Communication Strategic Planning Guideline" by NSW Finance and Services, 2011.

overarching strategic agenda and priorities, and reinforces the expectation that agencies are accountable for delivering services to the community. Aligning the strategic plans is not an easy task. Critical success factors appear to be top management commitment to the strategic use of ICT, ITD management knowledge of the business practices and operations of the organization, and management confidence in the ITD (Teo & Ang, 1999). Having a joint vision among all stakeholders and a planning team that consists of members from different areas of the organization (Bechor, Neumann, Zviran, & Glezer, 2010) and external partners (Blavin, Ramos, Shah, & Devers, 2013) are also important.

Little is written specifically about ICT strategic planning in public safety, though much can be gleaned from the literature in related fields, such as healthcare. Coye and Kell (2006) identified several barriers to effective ICT planning. Among these were "disruptive" technologies that make it difficult to construct a business case for investment; the preferences of practitioners or clients driving decisions about a particular technology rather than a framework for encouraging the appropriate adoption of beneficial technologies through evaluation; a tendency to make isolated decisions about individual technologies without integrating them into the organization's long-term mission and strategy; and a propensity to assume a "reactive posture" (para. 20) to emerging technologies rather than taking a pro-active approach managing their introduction into the organization. In her study of ICT in the public sector, Beaumaster (2002) concluded that (a) strategic planning for ICT is fundamental to the effectiveness of technology implementation, and (b) executive expertise with information technology is a contributing factor in successful ICT development and deployment.

Strategic planning for ICT is a complex and involved undertaking, regardless of the size of the organization. There are a variety of reference material and guidance on how to undertake the strategic planning process for ICT and the preparation of an ICT strategic plan itself. The use of outside expertise in the form of consultants and vendors can be beneficial (Imel & Hart, 2003; Thong, Yap, & Raman, 1997), though it creates an added expense to the process. The IAFC (2005a) advocates for inclusive representation in the technology planning team stating that "everyone affected by the fire communications system should have a hand in its selection" including front-line fire fighters and supervisors (end-users), fire department leadership, union representatives, elected officials, and outside stakeholders, among others (p. 9). Key elements of the plan should include an assessment of the department's current ICT environment/position; issues driving change; the strategy the department will use to address these issues; measureable outcomes and deliverables; and a governance and management framework that assigns accountability for achieving the desired results (NSW Department of Finance and Services, 2011).

ICT Implementation

Implementation is the organizational efforts focused on putting a technology into practice, managing change, developing necessary skills, and evaluating the impact and outcomes on service delivery. Traditionally, technology change within the fire service has been incremental though the increased pressure to change - either out of a demand for increased operational efficiency or to adapt to changing needs (or preferences) of the community - has resulted in a flurry of innovation in recent years. Missteps during implementation can increase resistance to change, slow adoption, lead to inefficiencies,

decrease effectiveness, and promote uncertainty. The IAFC (2005) identifies three critical steps to successful implementation:

- Set user expectations so they have a realistic expectation of the capabilities of the new system once it is deployed,
- Monitor any decisions and changes by carefully observing system acceptance tests to ensure the system conforms to specifications, and
- See that users are properly trained, otherwise the system will not be used to its full potential.

The implementation process must be inclusive since the affects of technology will be experienced throughout all levels of the organization (Ward, 1995). If an effective partnership exists between management, labor, and the Information Technology Department (ITD) when planning for a new technology is initiated, opportunities to add value to service delivery can be maximized and costly mistakes avoided. Interdepartmental coordination has been a continuing problem for ICT implementation (Beaumaster, 2002; Kerr, 1991). Failing to coordinate efforts between ITD and the fire department, as well as other supporting organizations, can lead to inefficiencies including duplication or incompatibility. The process of strategic planning for ICT plays an important role in facilitating interdepartmental coordination. End-users should also be engaged and empowered with the project. Organizations that are able to engage end-users and ancillary personnel during planning and development have demonstrated more success selecting and integrating new technologies (Blavin et al., 2013).

Fundamentally, implementation of new technology is about organizational development. Human beings become accustom to a particular way of doing things. This

is particularly true in the fire service where traditional thinking has been cited as one of the biggest obstacles to innovation (IAFC, 2013). Fire fighters are trained to perform with certain tools and within certain parameters becoming comfortable with their abilities. New technologies disrupt these work processes and present a new learning curve creating uncertainty and, potentially, resistance to change. Kurt Lewin (1952) describes a process of organizational change that incorporates three states: unfreezing, transition, freezing. Lewin's general theory aligns well with Walton's (1989) proposed three-phased framework for ICT implementation which calls for (a) shaping the context for ICT, (b) designing a system to match organizational needs, and (c) putting the system into practice. To unfreeze the organization, management must generate the context for technology by aligning organizational and ICT strategies. Communication is key to facilitating transition. "Open, two-way communication is vital to earning trust" (IAFC, 2005, p. 37). Having a dialogue about operational processes that would benefit from the use of technology and involving end-users in the ICT initiatives builds trust and buy-in to the new system. Training is a key form of communication in the implementation process as stakeholders ask questions, provide feedback, and share opinions (Wagstaff, 2006). Managing the rate of change helps members to adapt and accept new technology. The organization can "refreeze' by routinizing the usage of the new technology as a normal activity. The focus of ICT implementation then must be on managing change, developing the necessary skills, and formalizing the new routine within the organization.

Training and user support also help to alleviate anxiety and developing the skills necessary to effectively implement new technologies. A challenge in implementing ICT in today's multi-generational workforce is that individuals have different experience and

comfort levels with technology. Mark Prensky (2001) coined the terms "digital immigrant" and "digital natives" to discuss the generational differences in comfort level with technology. Digital natives were born after the introduction of mobile technologies and, as a result of interacting with technology from an early age, are very comfortable using it and quickly adapt to changes in the digital environment. Conversely, digital immigrants were born before modern technology but still use and adapt to it, thought it may take more time to do so. "Training best practices include obtaining organizational commitment to invest in training, assessing users' skills and training needs, selecting appropriate staff for training, matching training needs to users' needs, using multiple training approaches, levering the skills of role models" and "providing training support throughout the implementation process" (Blavin et al., 2013, p. 4).

Another important consideration in implementation is the speed at which technology changes are made in the organization. This is sometimes referred to as cutover (IAFC, 2005). Users will need time to adjust and develop the necessary skills before they can make effective use of new technologies. Blavin et al., (2013) explored the literature on the transition period for adoption of electronic health records in healthcare settings. They found that the greatest loss of short-term productivity was experienced when systems were implemented quickly, within one year. A hybrid approach, starting with limited introduction, voluntary use of the system at first, and duplication of existing and new systems, while less efficient, led to significant productivity gains. Timing is also important for jurisdictional partners. Some technologies – especially mission-critical voice communications systems – can pose a threat to fire fighter safety if all mutual aid partners and interoperability links are not ready.

"Arguably, the implementation phase never ends" (IAFC, 2005, p. 39). Metrics need to be designed and monitored to tract the outcomes associated with ICT initiatives. The lifecycle of technology means that decisions will have to be made about investing in software updates or implementing new applications and the need for ongoing maintenance requires that relationships with vendors managed. Resources will need to be allocated to providing ongoing user support long after a new technology is implemented and new employees will require initial training. Adding new partners to the mutual aid system will require installation of interoperability links. Introducing new technologies may require investments in upgrades to existing infrastructure. Organizations must also continually scan the environment for new technologies that will present challenges and opportunities – such as those that may come as a result of the NPSBN.

Evaluating ICT Implementation

ICT implementation evaluation seeks to determination the success or failure of a project and identifies potential remedies for mission-critical technologies. It can also help to justify investments in technologies by demonstrating project impacts and outcomes. Evaluating ICT projects, however, can be problematic and often subjective. There does not appear to be consensus on the best way to measure the effectiveness of ICT implementation. It has been suggested that researchers employ multiple methods for this purpose (DeLone & McLean, 1992). Hence, mixed-method approaches utilizing both quantitative and qualitative measures are often employed (Gichoya, 2005). For example, an instrument developed for a study by the Computer Science and Telecommunications Board used both semi-structured interviews and a written survey questionnaire to give an

overall assessment of ICT implementation performance (National Research Council, 1994).

Walton (1989) believes that effective ICT implementation is one that (a) serves to advance the mission of the organization, through improvements such as improved productivity and service delivery, and (b) positive effects on the organization's members, such as increased satisfaction. Indeed, user satisfaction has been identified as one of the most useful assessments of ICT implementation effectiveness. User satisfaction has been linked to the qualities of the user experience design (UXD) that is under the control of the developer who must "place great emphasis on ensuring, through systematic usability evaluations, that users can operate technology effectively, efficiently, and satisfactorily" (Dillon, 2001, para. 7). While there is a tendency of people to resist new technologies regardless of the system, all things being equal, they are less likely to resist systems that are well designed (Markus, 1983). A good UXD is one that is intuitive so that the user can quickly figure out the capabilities of the device. Users "should feel good when using technology so that they will be persuaded to continue onwards to mastering it (Ginsburg, 2013, para. 8). Rogers (as cited in Dillon, 2001) identifies five characteristics of technology that determine its acceptance:

- Relative advantage (the extent to which the technology offers improvements over existing tools),
- Compatibility,
- Complexity (ease of use),
- Trialability (opportunities to try the innovation before full implementation), and
- Observability (the extent to which technology gains are clear to see).

Thong et al., (1997) developed an instrument to measure three aspects of ICT implementation effectiveness they identified as important: user satisfaction, organizational impact, and overall ICT effectiveness. User satisfaction was measured in terms of the quality of the reports generated by a system query.

Summary

The fire service is being transformed by a continuous, and increasingly rapid, evolution in technologies that are changing the way things are done at a fundamental level. Nearly every aspect of daily operations is being affected by technological innovations. Advancements in ICTs are making it more practical and cost-effective to develop equipment to meet the specific needs of the fire service. This, in turn, helps promote safety and enhances the ability of fire fighters to work together effectively (IAFC, 2005). Emerging technologies such as wireless broadband connectivity have vast potential to improve the overall effectiveness of fire personnel by providing access to real-time data and audio/video feeds sent throughout the incident cycle. "People are increasingly relying on mobile phones and the Internet as their main source of information and communication" (West & Valentini, 2013, p. 17) during emergencies. Yet, integration of new technologies is becoming an increasingly complicated endeavor. This is particularly true in the public safety domain where significant operational challenges exist for ICT related to interoperability and compatibility, harsh operational environments, and equipment lifecycle concerns. The need for effective strategic planning and implementation of technology has never been more important.

There are several important themes that emerge from the literature, either explicitly or implicitly. First, strategic planning for ICT begins with strategic thinking. It

is important to define what the future should look like and how and where technology best supports that vision. This requires that the environment be continuously scanned for emerging technologies and systems that will influence fire department operations (i.e. FirstNet, social media). How technologies address the core values and mission must also be considered. The department's strategic plan and ICT strategic plan should be aligned, which these must also be aligned with a citywide technology roadmap and community priorities. A second important consideration is that the process must be inclusive. Emphasis is made on the need for end-user and stakeholder involvement in the entire planning and implementation process. Those who implement technology plans need to embrace them. Including end-users in the process from the beginning helps gain buy-in and a sense of ownership; thereby, when the technology is implemented, it is done so by strongly committed users. Interdepartmental coordination is essential to the efficiency of implementation. A third theme is that the competency of users with a technology is key to implementing it to its full potential. Continuously available training and end-user support is critical to building skills. Lastly, technology needs to be well designed to be effective. A well-designed technology will have an intuitive user interface; will be interoperable and compatible with existing systems; and have a relative advantage over existing systems or work processes.

Procedures

The overall research design for this applied research project was descriptive in that it made use of literature and document reviews, interviews, and a questionnaire to explore the issues affecting public safety ICT planning and implementation in Mesa, especially with regard to the needs and perceptions of key stakeholders and end-users.

Isaac and Michaels (1981) note that the purpose of descriptive research is to collect detailed factual information that describes existing phenomenon and/or to identify problems or justify current conditions and practices. This study makes use of these purposes in that the objective was to describe the current state of ICT implementation and to identify the most problematic issues in implementation.

Several people provided critical support to this project. The study was conducted at the direction of the Mesa City Council and the City Manager's Office with support from the TRWC Board of Directors. This helped to facilitate participation in a project that involved multiple city departments and jurisdictional partners. Given the increasingly complex nature of ICT, the City retained a consulting firm to conduct a technology needs assessment and assist in citywide ICT strategic planning efforts. Using "outsiders" has been demonstrated to improve the effectiveness of strategic planning (Robinson, 1982). The consultant served as a methodological advisor providing assistance with data analysis and the presentation and dissemination of the research findings (Ader, Mellenbergh, & Hand, 2008). In addition, the consultant proved invaluable in data collection, as anonymity was important ensuring non-attribution so that participants felt comfortable speaking openly.

The literature reviewed suggested multiple methods be used to evaluate ICT implementation success (DeLone & McLean, 1992; Gichoya, 2005), hence the research design for this project uses a mixed-method approach utilizing both quantitative and qualitative techniques (Gichoya, 2005) to evaluate ICT planning and implementation in Mesa. Several research methods were employed to ensure that sufficient information was collected for this project. These techniques are described in the follow sub-sections.

Literature Review

This research project addresses how public safety ICT technologies are planned for, managed, and implemented in the City of Mesa. A literature review was conducted to identify the prevalent issues surrounding technology in the public safety domain, ICT strategic planning in the public sector, and the process of implementing technology in organizations. These issues are extremely important as they provide a foundation for current and future trends in technology used in the fire and medical services. In addition, this literature pointed a way toward an appropriate methodology that could be applied to explore operational or capacity issues surrounding technology implementation, and end-user and stakeholder perceptions of the current state of specific public safety technologies in Mesa.

Research began at the Learning Resource Center (LRC) at the National Fire Academy in Emmitsberg, Maryland. The LRC is a small research library that maintains a collection of applied research materials, books, and trade publications specific to fire and emergency services. The LRC online catalogue and EFOP Applied Research Projects Portal provided distance access to library materials. Additional materials were obtained from the ASU libraries. The ASU libraries' online service "One Search" accesses dozens of top research databases, including 26 related to computer science and 14 containing materials in communications. Search engines accessed included Google, Google Scholar, and the Mesa Council, Board and Committee Research Center. Relevant literature was identified searching databases using the keywords *information technology strategic planning, strategic information systems planning*, *SISP, information systems plan*,

information technology plan, and *technology implementation*, combined with *fire department* and *public safety*.

Document Review

In order to facilitate the gathering of information in support of this project, information was requested from City ITD, the fire and police departments relevant to ICT programs and projects. Documents requested included any existing strategic plans, the current Capital Improvement Plan (CIP), results from employee satisfaction surveys for the City of Mesa related to ICT services, and City Council presentation related to ICT. Departments were also asked to submit any additional documentation they felt would be relevant to the project. Specifically, the following documents were reviewed:

- Mesa Fire and Medical Department Strategic Initiatives 2011-2013
- Mesa Information and Communications Department technology roadmap
- Fire Apparatus Technology Plan 2013
- Mesa Police Department IT Unit Strategic Plan, Fiscal Year 2012-2013
- Mesa Fire and Medical Department Strategic Plan

Reviewing existing documents provided the necessary background to understand the City's and public safety's current technology environments; it was also useful in formulating questions for stakeholder interviews and an end-user questionnaire. Departments were asked to provide the requested documents in electronic format however, hard copies were provided when an electronic version was not available. In some instances, information was publically available online. Document review also helped reveal any discrepancies between formal statements of program purpose and actual program implementation.

End-User Questionnaire

A list of technologies and systems used in the scope of public safety operations was obtained from the MFMD and City ITD. The compiled list of 60 fire department relevant public safety systems was used as the foundation for a questionnaire. The City's ICT consultant devised a computer-based data collection instrument to determine whether the current technology meets the operational need and identify those technologies that pose a major or minor operational issue to the end-user. The questionnaire was distributed by the City Manager's Office to all 389 fire department employees and a few employees in the City ITD who support public safety systems. The answers provided by the 227 employees who responded to the survey are contained in the Results section. The overall response rate to the survey was approximately 58% of those eligible to participate. All MFMD and City ITD staff that support MFMD information technology functions are represented in the results.

Anonymous responses to the questions were collected through the survey tool. The questionnaire asked each respondent to provide the following information: primary job responsibilities, length of service, department and division within their department. Respondents were then asked to describe the functional issues impacting the usability of a technology or system as a "Major Issue," a "Minor Issue," or "Meets My Needs." This is consistent with a three-tier scale used by Beaumaster (2002) to measure issues in public sector ICT strategic planning. A screenshot of the satisfaction with the technology questions is provided in Figure 2. The respondents were also asked to identify the characteristics that they liked or disliked about each technology or system (Figure 3). Characteristics identified for evaluated included Functionality/Features, Ease of Use,

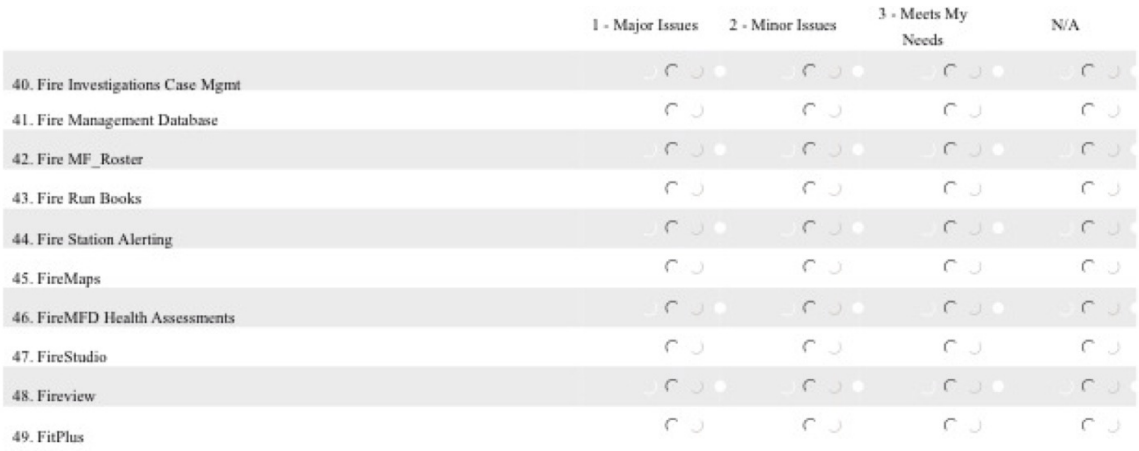

Figure 2. Computer display with questions about satisfaction with the technology.

Responsiveness, Reliability (Dillon, 2001; Ginsburg, 2013), Queries/Reporting (Thong et al., 1997), and System Training (Wagstaff, 2006; Blavin et al., 2013).

The questionnaire included nine general questions about Mesa's investment and deployment of technology and the adequacy in support of public safety operations. Answers were recorded as "Strongly Disagree," "Disagree Somewhat," "Agree Somewhat," "Strongly Agree," or "Not Applicable." The statements were as follows:

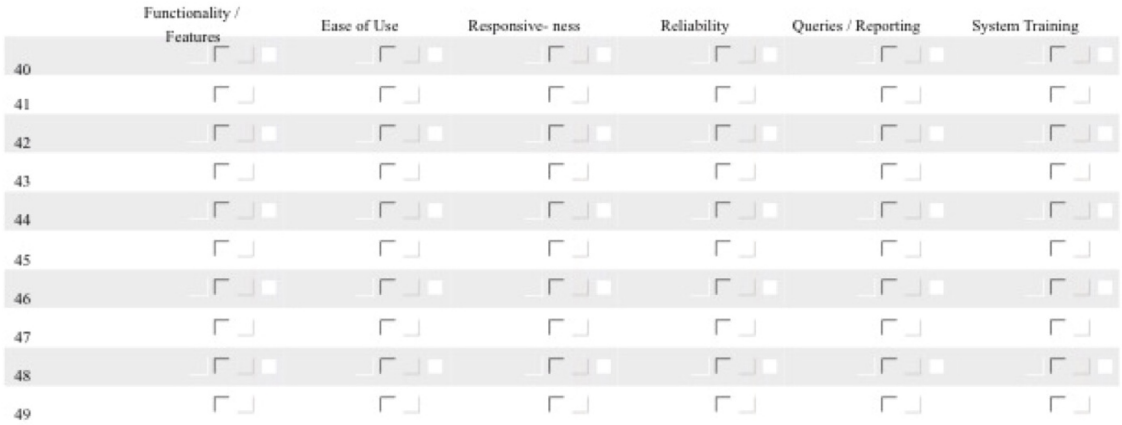

Figure 3. Computer display with questions about the features of the technology.

1. The City of Mesa does an effective job of planning for the technology needed to support public safety.
2. I am asked for my in put on the technology that I need to do my job.
3. When the City of Mesa invests in new technology, the technology is implemented to its full capacity.
4. When new technologies or changes to existing technologies are introduced, I receive the training I need to do my job effectively.
5. The City of Mesa does an effective job of planning for technology maintenance needs and upgrades to systems or applications.
6. When I interact with the City's Information Technology Department, I find they are timely and responsive in meeting my needs.
7. When I interact with Fire IT, I find they are timely and responsive in meeting my needs.
8. I fee that the City of Mesa uses state-of-the-art technology to support delivery of public safety services.
9. Overall, I am satisfied with the technology that I use to do my job.

Finally, respondents were asked three open-ended questions about suggestions for new technologies to support current and future operations, specific processes that would benefit from a technology solution, and any additional comments that might be beneficial to the intent of the research.

The questions developed were tested for reliability by means of a test/re-test technique (Carmines & Zeller, 1979; Edwards, 1957). A paper version of the questionnaire – shortened to 10 technologies and the nine multiple choice questions –

was administered at a "time one" point, then the order of presentation of the items randomized and the questions re-administered to the same group ten days later. Five individuals with knowledge of these technologies, but otherwise not eligible to participate in the survey pool, served as the group on which the questions were pre-tested. A Pearson's product-moment correlation between the first and second administration was calculated to determine the reliability of the questionnaire. The correlation was $r = .92$. Using Edward's criterion that correlations above .80 represent acceptable reliability, the questionnaire was deemed to be reliable.

Stakeholder Interviews

Semi-structured interviews were conducted to assess key stakeholder needs, understand the strategic vision for ICT in supporting public safety services, and to obtain their perspectives of current technologies and near-future needs. A total of 45 interviews were conducted with City ITD managers, police and fire department leaders, and union representatives. Each stakeholder was sent a preliminary email explaining the project and its purpose. The email also contained a copy of the interview questions for the stakeholder to review prior to the actual interview, a brief statement of why they had been selected as a stakeholder in the process, and available dates and times to be interviewed.

It was decided to outsource the interview process using trained interviewers provided by the ICT consultant. There were several reasons for this. A primary concern was that it is not appropriate for researchers to interview their subordinates. ("Assessing technology," 2011). Interviewing also requires specialized training and it was determined that the City did not have staff with the requisite experience to conduct good interviews, particularly in the technology field. The trained interviewers had greater industry

knowledge and qualitative interview experience that allowed them to probe deeper resulting in more meaningful data.

Interviews were held over a 15-day period between September 17th and October 5th. Most interviews were conducted in-person, during which interviewees were provided with an overview of the project's purpose, process, and objectives. A series of follow-up interviews were also conducted with 21 stakeholders to validate and clarify the information previously gathered. Interviews were typically conducted with one interviewer who took notes during the discussions. Participants were informed that their responses would be recorded in writing and kept strictly confidential. A series of open-ended questions explored interviewees' assessment of the ICT system needs. Questions were modified slightly or not asked at all depending on the relevance to the stakeholder allowing questions to be focused on topics most germane to the mission of the department or section they represented. Ample time was allowed to fully explore the interviewee's insight. The structure of the interviews enabled individuals to be more candid and in-depth than they otherwise might have been if they had been conducted in a focus group or open forum. At the conclusion of the interview, the participant was asked for any additional comments.

Following interviews with City of Mesa personnel, interviews were conducted with automatic aid partner jurisdictions, including Gilbert, Queen Creek, Apache Junction, and Rio Verde to understand their perspectives on how public safety technologies support the partnerships and, specifically, the delivery of fire and emergency medical services. These interviews were conducted as a series of meetings from December 19th and 27th, with each jurisdiction having its own meeting.

Jurisdictional partners were represented by between two to five chief fire officers; Apache Junction also included two technologists in their meeting. Since participants were interviewed as a group, they were asked to come to a representative consensus for their responses.

Analysis of Interview Data

Data collected from key stakeholder interviews were summarized, coded, and interpreted using a systematic process of thematic content analysis (Flick, 2007; Patton, 2002; Weber, 1990). "Content analysis is a set of procedures for collecting and organizing information in a standardized format that allows analysis to make inferences about the characteristics and meaning of written and other recorded material" (GAO, 1989, p. 6). A satisfactory content analysis "portrays the thematic content of interview transcripts (or other texts) by identifying common themes in texts provided for analysis" (Anderson, 2007, para. 2). In other words, content analysis allows a researcher to understand the importance of a topic by its presence or relevant counts in a text, in this case interview notes. This method allowed a deeper insight and understanding of a range of perspectives about the challenges and needs of public safety ICT in Mesa.

This research project utilized a hybrid approach to coding and theme development (Fereday & Muir-Cochrane, 2006) in that it applied both inductive and deductive processes. The analysis was inductive in that it involved discovering patterns, or themes, present in the data themselves (Patton, 2002), but was also guided by a set of research questions and informed by a literature review making the process more "analyst-driven" (Mays, Pope, and Popay, 2005). Themes emerged from key stakeholder interviews through a process of collecting, analyzing, and categorizing interview notes (Strauss &

Corbin, 1998). The process began by reading a printed copy of the interview comments and highlighting key sets of words or phrases. These phrases were abstracted and labeled with a code. Once all the stakeholder comments were coded, they were sorted by code, and similar concepts were grouped into categories. Pattern coding was then performed to group the initial codes into a smaller number of overarching themes (Miles & Huberman, 1994). A record of all the coded statements grouped by theme is provided in Appendix B. Themes that emerged from this analysis are incorporated into the Findings and Discussion sections.

Limitations and Assumptions

It is important to recognize that the issues and results presented in this report are not a comprehensive assessment of the needs, opportunities and challenges in Mesa's public safety ICT programs. Furthermore, the purpose of the research was not to statistically prove relationships between demographic variables and acceptance of ICT. Although there have been studies to show that a causal relationship exists between some variables (Dillon, 2001), this applied research project set out to simply identify and describe the most problematic issues with ICT implementation in Mesa. Since this project did not assess the influences of operational environments, personal attitudes toward the use of computers and technology, or any other external factors, a key limitation of this may be derived from distortion of the perceptions of individuals about ICT and its relationship to their work environment.

The stakeholders selected for interviews were not randomly sampled from the population nor were their responses weighted. Regional partners interviewed did not speak for the TRWC automatic aid consortium as a whole rather they spoke for

themselves and their organizations. One of the inherent limitations of interviews is the subjectivity of the respondents. In using interviews, the research relied on the honesty and accuracy of participants' responses. An individual's closeness or buy-in to the existing process may bias responses to questions. To attempt to address these concerns, ICT consultants with experience in interviewing conducted the stakeholder interviews. The disadvantage is that the interviewers may not understand the customs and culture of the fire service potentially impacting the information collected. Additionally, responses to the interviews were paraphrased during transcription to ensure anonymity. In doing so, interpretation of the data becomes as much a matter of judgment than merely a technical task. When data have been transcribed in this way, they are not raw data any more – they are "processed data" (Wengraf, 2001, p. 7).

It is also important to acknowledge the limitations of thematic analysis. Unlike quantitative and deductive methods, there is a lack of a clear and concise framework to guide data extraction and analysis (Mays, Pope, & Popay, 2005). Thematic analysis relies on inductive reasoning. While this makes for a flexible methodology, it is also subjective in that it is up to the researcher to identify patterns in the text, code the data, and modify the analysis as ideas develop. This can limit its interpretive power (Braun & Clarke, 2006) and raise concerns about reliability, researcher bias, and generalizability. However, some of these issues are tempered by the hybrid approach taken to theme development. Using a process that includes both inductive and deductive processes in coding has demonstrated improved methodological rigor (Fereday & Muir-Cochrane, 2006).

A questionnaire was the data collection instrument employed to gather end-user perspectives on how effectively existing public safety technologies are supportive of their

needs. Instead of taking a probability sample from the population of fire personnel in the MFMD, an email was sent to all 389 fire department employees and a response rate of 58% was achieved. Since this research used descriptive rather than inferential analytical techniques, this approach is appropriate (Babbie, 2005; McDavid & Hawthorn, 2006). It should be noted that the test for reliability was conducted *after* the administration of the survey, which is outside of normal research practice. However, the results indicated an instrument that was reliable. Finally, while this report provides a good assessment of current state and needs of ICT in Mesa, the results cannot be generalized to other fire departments, including those in the TRWC automatic aid consortium, or outside public safety organizations.

Results

This applied research project addresses issues affecting public safety ICT planning and implementation in Mesa, especially with regard to the needs and perceptions of end users and key stakeholders. Answers to the research questions are integral to gaining an understanding of the current state of public safety technologies used by the MFMD, and identifying challenges and opportunities associated with ICT planning and implementation processes. This section presents the findings from the data collection and analysis described in the previous section.

Question 1. *How well do existing technologies meet the needs of the fire department end-user?*

A list of 60 public safety systems were identified and used as the foundation of the questionnaire to determine whether current technologies and systems meet the operational needs of the end-user. Respondents were asked if the technology or system

Table 1

Fire Technology Systems Survey Responses

All Fire Systems	Major Issues	Minor Issues	Meets User's Needs	% Meets	% Major Issues
Tandberg Video Conferencing	42	73	56	32.75	24.56
Electronic Patient Care Report (ePCR)	32	78	72	39.56	17.58
RMS: FireHouse CAD Interface	20	44	56	46.67	16.67
Ambulance Billing Services	1	9	9	47.37	5.26
RMS: FireHouse	28	51	81	50.63	17.50
Wireless Devices	9	38	53	53.00	9.00
Wireless	12	27	46	54.12	14.12
In Car Video System	2	9	14	56.00	8.00
RMS: Fire – Reporting Services	6	9	21	58.33	16.67
Laptops	9	25	54	61.36	10.23
Target Safety	8	60	109	61.58	4.52
CAMEO Suite	1	13	23	62.16	2.70
Fire Exceptional Incident Reporting	6	44	83	62.41	4.51
Recruiting Websites	6	12	32	64.00	12.00
Paging Systems	6	16	40	64.52	9.68
Fire Management Database	5	18	42	64.62	7.69
Fire Investigations Case Management	4	9	24	64.86	10.81
GIS/Mapping	11	19	56	65.12	12.79
Command and Control Systems	6	16	44	66.67	9.09
LAN	3	10	26	66.67	7.69
Health EMS: Fire	19	31	101	66.89	12.58
Hospital Alerting	2	28	63	67.74	2.15
Audio/Visual Systems	8	22	64	68.09	8.51
Desktop Systems	11	37	103	68.21	7.28
FireStudio	5	7	26	68.42	13.16
Administrative Phone System	11	23	74	68.52	10.19
Fire Run Books	12	32	105	70.47	8.05
Fire Maps	12	34	113	71.07	7.55
Emergency Management Systems	6	22	70	71.43	6.12
RMS: Fire Accounts Receivable/MARS	2	2	10	71.43	14.29
Net Motion	0	4	10	71.43	0.00
Mobile Data Systems	8	24	85	72.65	6.84

(Table continues)

Table 1 cont.

Fire Technology Systems Survey Responses

All Fire Systems	Major Issues	Minor Issues	Meets User's Needs	% Meets	% Major Issues
Asset Manager: Fire	2	5	19	73.08	7.69
Computer-Aided Dispatch (CAD)	14	26	112	73.68	9.21
FireMFD Health Assessment	5	32	107	74.31	3.47
Weather Station	1	9	29	74.36	2.56
Databases	6	13	57	75.00	7.89
WAN	5	1	18	75.00	20.83
Personnel Related Systems: Fire	1	12	40	75.47	1.89
CAD History	8	20	87	75.65	6.96
9-1-1 Telephone System	9	13	76	77.55	9.18
PEAC	1	6	26	78.79	3.03
Scheduling: WebStaff	5	27	121	79.08	3.27
Haz Mat Management & Tracking	4	7	43	79.63	7.41
Fire Station Alerting	6	28	133	79.64	3.59
Phoenix FireWire Website	2	6	33	80.49	4.88
RMS: Fire – Tech Services	2	6	34	80.95	4.76
LandView	2	4	26	81.25	6.25
Send Word Now	2	4	28	82.35	5.88
Scheduling: PDSI Telestaff	2	14	26	82.61	2.17
Remote Access (Citrix)	3	5	46	85.19	5.56
FitPlus	1	3	25	86.21	3.45
Scheduling: DB Backups Telestaff	1	8	57	86.36	1.52
Fireview	2	2	26	86.67	0.00
C-Cure	0	2	13	86.67	6.67
Customer Relationship Management	1	8	59	86.76	1.47
Fire Apparatus	1	18	143	88.27	0.62
Fire MF_Roster	3	12	113	88.28	2.34
MS Office Suite	0	10	105	91.30	0.00
Fire Fleet Focus	0	5	88	94.62	0.00

has “Major Issues,” “Minor Issues,” or “Meets My Needs”. The following responses were received regarding their view of the technology or system. Table 1 presents the findings listed in order of the percentage of respondents who felt the system meets the user’s needs from least to most.

Of the 60 systems used by the fire department end-user, 3.3% (n=2) were viewed as having a Major Issue by 20% or more of the respondents – the Tandberg Video Conferencing (24.56%) and Wireless Area Network (20.83). More than half (56.67%, n=34) of the fire department systems garnered a rating of Meets My Needs by 70% or more of the respondents. Functionality/Feature, Responsiveness, and Reliability were most often cited as the contributing factors for those systems rated as having a Major or Minor Issue.

Systems with a Meets rating of less than 50% or systems identified as being a priority to operations were reviewed in more detail. The systems requiring further review included Tandberg Video Conferencing, ePCR, RMS: Firehouse CAD Interface, and Ambulance Services Billing. Only one system – RMS: Firehouse – received a greater than 50% Meets rating, but was included for further review at the request of Fire Administration. Respondents that indicated the system has Major or Minor Issues selected the system characteristics with which they are most dissatisfied.

Tandberg Video Training System. Table 2 presents additional detail about the Tandberg Video Training system. This system received the lowest Meets rating (32.75%) of any of the technologies or systems used by the fire department. Forty-two respondents (24.56%) reported Major Issues with Tandberg and 73 had Minor Issues (42.69%). Supervisors gave the system its lowest Meets rating (26.23%), while first responders

Table 2

Tandberg Video Conferencing System

	Rating				System Characteristics					
Tandberg Video Conferencing	Major Issues	Minor Issues	Meets Needs	% Meets	System Training	Functionality/ Features	Ease of Use	Responsiveness	Reliability	Queries/ Reporting
	42	73	56	32.75	46	51	25	40	1	22
Breakdown by Job Responsibility										
First Responder	21	39	36	37.50	21	19	14	18	1	8
Supervisor	19	26	16	26.23	22	27	8	18	0	12
Support Staff	2	8	4	28.57	3	5	3	4	0	2

rated it slightly better at 37.75%. Ease of Use was the system characteristic most reported as problematic, followed by Functionality/Features and Reliability. The most problematic system characteristic varied somewhat depending on job responsibility. First responders found Functionality/Features most troublesome (n=21) while supervisors and support staff considered Ease of Use to be the biggest problem (n=27 and n=5, respectively). Only one respondent identified Queries/Reporting as an issue.

Responses to the open-ended questions were reviewed for comments relevant to the technologies receiving a Meets rating below 50%. Comments are reproduced here exactly as set down by the original writer except where it was necessary to ensure non-attribution. In order to retain the integrity of the entire comment, some comments may appear several times in this section if they are germane to two or more of the technologies being reviewed. The key themes identified from these open comments pertinent to the Tandberg Video Training system were the perceived need for better Internet connectivity and data signaling rates (speed).

- Having fast computer systems “fiber optic” to not have to wait so long to sign on and do normal computing and training videos are impassible at best at Sta 204.
- The city needs to expedite fiber installations to public safety facilities. Many applications are being held back due to lack of bandwidth.
- The infrastructure needs to be upgraded at all of the fire facilities so that online computer based training and Tandberg video conferencing can be utilized to its fullest capacity.
- I think the City does a good job in trying to develop technology or implement technology to assist the City and various departments. However, in my work area we consistently have slow network connections, system failures and poor coverage for Wi-Fi. Because of this we are unable to fully utilize the technology we have. In addition, often the new technology is implemented without having adequate support for training and education.
- The city network is painfully slow. Streaming video clips are almost unwatchable.
- Multiple fire stations need better quality Internet connections to view training videos in Target Safety and other training systems.
- Increase the bandwidth to all fire/medical stations a.s.a.p. so we can view training videos.
- We need a system that provides our video training through our Day Room TVs so that we can watch as a group rather than individually. The speed of the computer systems is very slow and sometimes training videos will not download to our computers.
- Target Solutions is not a practical system for training because it is slow in stations

that do not have fast internet service, it requires a certain amount of time to complete an assignment and if crews get calls while attempting to complete the assignment, it will time out and the student will have to begin all over again. This can happen constantly when assigned to a busy unit making completion of assignments impossible and frustratingly more punitive then educative.

ePCR. A key technology implemented by the MFMD in the past few years has been ePCR. The system enables electronic sharing of patient information between fire department paramedics, hospitals, and transportation providers (Raines, 2010). Table 3 presents the results of the detailed review of problematic features. The ePCR system received a Meets rating of 39.56%. Just over 53% of first responders felt that ePCR met their needs, while only 25% of support staff felt that way. Thirty-two respondents (17.58%) reported Major Issues and 78 (42.86%) had Minor Issues. Overall, Reliability (n=53) was the system characteristic reported as most problematic followed closely by

Table 3

Electronic Patient Care Report (ePCR)

	Rating				System Characteristics					
Electronic Patient Care Report (ePCR)	Major Issues	Minor Issues	Meets Needs	% Meets	System Training	Functionality/ Features	Ease of Use	Responsiveness	Reliability	Queries/ Reporting
	32	78	72	39.56	66	47	50	53	26	13
Breakdown by Job Responsibility										
First Responder	14	50	45	41.28	39	30	31	29	15	5
Supervisor	14	25	20	33.90	22	16	17	20	7	5
Support Staff	4	3	7	46.15	5	1	2	4	4	3

Reliability (n=50). First responders rated Functionality/Features (n=39) as their highest concern with Responsiveness (n=31), Ease of Use (n=30), and Reliability (n=29) mentioned frequently as well. Supervisors (n=22) and support staff (n=5) were least satisfied with ePCR's Functionality/Features.

Responses to the open-ended questions were reviewed for comments relevant to the ePCR electronic patient medical report system. Users had many comments and concerns about the ePCR system. Many felt that the hardware and software were obsolete and in need of upgrading, and several users documented database interoperability challenges among different systems used by the MFMD.

- The Panasonic Tough Books are beat up and are beginning to become outdated. If ePCRS is what we are going to use we need to upgrade to a tablet system like iPad or Fujitsu. The Fujitsu tablet is already compatible with Health EMS. This is the first time I can remember being asked what we need for the future and I appreciate the opportunity to respectfully participate in the betterment of our customer service delivery.
- The ePCRS computers are outdated and need to be replaced. The ePCRS computers are very slow and restart at times without warning. ePCRS computers also freeze up often and have to be rebooted.
- A system that allows CAD to function as an effective database. Upgrading the ePCRS program from both the user and the information mgt. perspective.
- Firehouse, CAD and ePCRS' all capture data in separate databases. Those databases are connected but in some cases do not carry all the information from one place to another. Research has to be done across three sources often with

different results due to filtering of transfer information. ePCRS has limitations from the vendor on the amount of data that can be viewed and printed and/or mapped. Firehouse is very difficult to search and there is little formal training for either program. There is upgrade software available for CAD and the ePCRS vendor has responded in some ways to pressure to improve.

- Fire ePCRS seems outdated, is slow and is not user friendly. Both hardware and software needs to be upgraded.
- A lighted keyboard on the ePCRS.
- Better ePCRS. Perhaps one that is somewhat up with the current times. Lighted keyboard. Better communication between programs. (i.e. Firehouse, iMobile, Sansio)
- Don't implement a system if not reliable and functional, i.e. ePCRS, Telestaff.
- ePCRS needs to be upgraded to better equipment that is not ten year old technology.
- Our ePCRS is not adequate. They are way too slow! When Health EMS is accessed from a desktop computer, it is fast and responsive, and when accessed from our laptops with air cards it is terrible.
- Revisiting the ePCRS contract with Sansio. We have not seen improvements in the software, and the system has frequent hiccups.
- The ePCRS program from Sansio is horrible. I am one of the ePCRS "trainers" for the Department, and I am shocked at how bad the software has performed over the last three years. There are MAJOR bugs in the software that we have made Sansio aware about, and they have not addressed them. For example, calls with

patient information (HIPPA) will sometimes just "disappear" as our members are completing the forms. Our members then have to go back and re-enter the patient (and call information) in a new form to the best of their ability. The fact that this happened once is unacceptable. The fact that it's been happening for three years and has not been addressed by Sansio is completely unbelievable. There are a lot of other problems with the software as well. It's not intuitive, or easy to use at all. The program was not designed for pre-hospital setting, so it doesn't really "flow" with how we run our calls. Our members have done a great job of making the best of it, but it's really not suited to what we do and how we do it. Out Department has spent, and continues to spend, hours and hours every week manually adjusting calls and "fixing" them so that they eventually are cleared out of the system and bridge with Firehouse. To me, this is another example of how the software doesn't leverage technology to be more efficient. It's actually ends up being more time consuming. And, we're still paying for it. Unbelievable. Also, the hardware we're using is so outdated; it's almost a joke. We could be using tablets (rumor is that tablets are being evaluated), and hopefully the fact that the tablets are on cycle replacement; the next hardware we get will be leaps and bounds better than these Toughbooks. The data mining, querying, ability of the software is also horrible. We have the ability to query from healthems.com, but there are so many limitations on the queries, that the process of getting data out of the system is vary laborious.

Firehouse CAD Interface. Firehouse CAD Interface received a Meets rating of 46.67% from a total of 120 respondents (Table 4). Only 16.67% (n=20) reported Major

Table 4

Firehouse CAD Interface

	Rating				System Characteristics					
RMS: Firehouse CAD Interface	Major Issues	Minor Issues	Meets Needs	% Meets	System Training	Functionality/ Features	Ease of Use	Responsiveness	Reliability	Queries/ Reporting
	20	44	56	46.67	25	18	17	19	17	11
Breakdown by Job Responsibility										
First Responder	6	25	35	53.03	9	6	9	10	8	5
Supervisor	9	18	18	40.00	12	9	8	7	7	4
Support Staff	5	1	3	25.00	4	3	0	2	2	2

Issues with Firehouse CAD so much of its rating below 50% was accounted for by those reporting Minor Issues (36.67%, n=44). Here again, first responders felt the system met their needs (53.03%) more than did supervisors (40.0%) or support staff (25.0%). Functionality/Features (n=25) was the system characteristic reported as most problematic while System Training was reported the least (n=11). The top concern for first responders was Reliability (n=10) while Functionality/Features was the leading issue for supervisors (n=12) and support staff (n=4).

Only a few open comments were relevant to the Firehouse CAD Interface. These mainly focused on interoperability between data management systems and software.

- Connectivity to Citrix needs to be addressed. If Firehouse and CAD had a way to interface up to date information would be readily available for Dispatchers to use. Additional resources need to be considered to address the lack of hazardous materials reporting.
- A better interface between Firehouse and the Sansio program. Too much time

spent correcting errors between systems. More tech assistance in fire dispatch to keep up with the mapping.

- The fact that the three primary data collection systems in fire; Firehouse, CAD and ePCRS share only certain pieces of data, means that research must be done across all three systems. All the systems collect the data well, but getting data back out is often a major issue.
- Firehouse software requires an expert user to obtain relatively simple search questions. One person in Fire IT is the expert and thus we often have to funnel simple work through him to get an answer.

Ambulance Services Billing. Few fire department personnel have access to the Ambulance Billing Service software system. In fact, only 19 respondents rated the system in the survey. Nevertheless, the Ambulance Billing System is a critical system to achieve some level of cost recovery for EMS response. The system received a Meets rating of

Table 5

Ambulance Service Billing

	Rating				System Characteristics					
RMS: Firehouse CAD Interface	Major Issues	Minor Issues	Meets Needs	% Meets	System Training	Functionality/ Features	Ease of Use	Responsiveness	Reliability	Queries/ Reporting
	20	44	56	46.67	25	18	17	19	17	11
Breakdown by Job Responsibility										
First Responder	6	25	35	53.03	9	6	9	10	8	5
Supervisor	9	18	18	40.00	12	9	8	7	7	4
Support Staff	5	1	3	25.00	4	3	0	2	2	2

Table 6

RMS: Firehouse

	Rating				System Characteristics					
RMS: Firehouse CAD Interface	Major Issues	Minor Issues	Meets Needs	% Meets	System Training	Functionality/ Features	Ease of Use	Responsiveness	Reliability	Queries/ Reporting
	20	44	56	46.67	25	18	17	19	17	11
Breakdown by Job Responsibility										
First Responder	6	25	35	53.03	9	6	9	10	8	5
Supervisor	9	18	18	40.00	12	9	8	7	7	4
Support Staff	5	1	3	25.00	4	3	0	2	2	2

47.37%. Only one respondent, a supervisor, indicated the system had Major Issues, nine others reported Minor Issues and nine felt the system Meets Needs. Queries/Reporting (n=5), Reliability (n=3), and Functionality/Features (n=3) were the top system characteristics which respondents were most dissatisfied with (Table 5). No comments were entered about the ambulance billing system in the open-ended questions.

RMS: Firehouse. The RMS: Firehouse system received a rating above 50% Meets rating (50.63%) but was identified by fire administration as a priority operational system so it was included for further review. Twenty-eight respondents (17.5%) reported Major Issues and 51 (31.88%) reported Minor Issues with RMS: Firehouse. Ease of Use was the system characteristic most users were dissatisfied with, followed by the system's Functionality/Features and Queries/Reporting. The results of the survey are illustrated in Table 6.

The end-user comments captured in the open-ended questions reflect a desire to have fully interoperable records management database systems.

- Find more user-friendly software. The Firehouse RMS is terrible! Not user friendly in any way, shape or form.
- Firehouse, CAD and ePCRS' all capture data in separate databases. Those databases are connected but in some cases do not carry all the information from one place to another. Research has to be done across three sources often with different results due to filtering of transfer information. ePCRS has limitations from the vendor on the amount of data that can be viewed and printed and/or mapped. Firehouse is very difficult to search and there is little formal training for either program. There is upgrade software available for CAD and the ePCRS vendor has responded in some ways to pressure to improve.
- Find a way for Firehouse and our Health EMS systems to work together or have only one system, currently the final types don't match up.
- Firehouse seems redundant. It's not user friendly at all and time-consuming. Target Solutions seems like a much easier way to track employee data.
- We need to have ONE SYSTEM to enter call data whether it's an EMS call, a fire call, a service call, or whatever type of call. Currently, we need to enter EMS calls on the ePCRS and any "non-EMS" calls in Firehouse and eventually the EMS calls are bridged over into Firehouse. I feel that this process is very inefficient and can be labor intensive. In my opinion, while there would be more up front cost, we could contract with a software developer to build a custom system for the Fire department, manage the database locally with backups, task a small IT team to manage the system. In the long-term, this would be more cost effective, actually leverage technology, be easier to use for our members, and deliver valuable data

to Senior Staff.

- If a program is purchased, like RMS, please purchase the whole program so that the functionality of the program is actually useful. Only having part of the system like we do now creates all kinds of shadow systems to create and disseminate reports and data.

Figure 4 displays the responses to the nine general questions about Mesa's investment and deployment of technology and the adequacy in support of public safety operations. Two questions were relevant to the current state of technology used by the MFMD. First, the majority of respondents felt that the City of Mesa uses state-of-the-art technology to support public safety. Sixty-one strongly agreed and 77 agreed somewhat with the statement, "I feel the City of Mesa uses state-of-the-art technology to support public safety services. Fifty-four disagreed somewhat and 11 strongly disagreed with the statement. Second, most respondents either strongly agreed (n=67) or agreed (n=97) that they were satisfied with the technology they use to do their job; 33 disagree somewhat and seven strongly disagreed.

Question 2. *Does the City's current ICT support system ensure the efficient and effective implementation of new public safety technologies?*

The end-user questionnaire contained four statements used to measure perceptions about various aspects of the City's efforts to implement public safety technology. Overwhelmingly, respondents did not feel that the City implements the public safety Effectiveness of technology implementation systems it purchased to their full capabilities. Only 37.7% of end-users strongly agreed (n=26) or agreed (n=60) with the statement new technology is implemented to its full capacity, while 85 disagreed

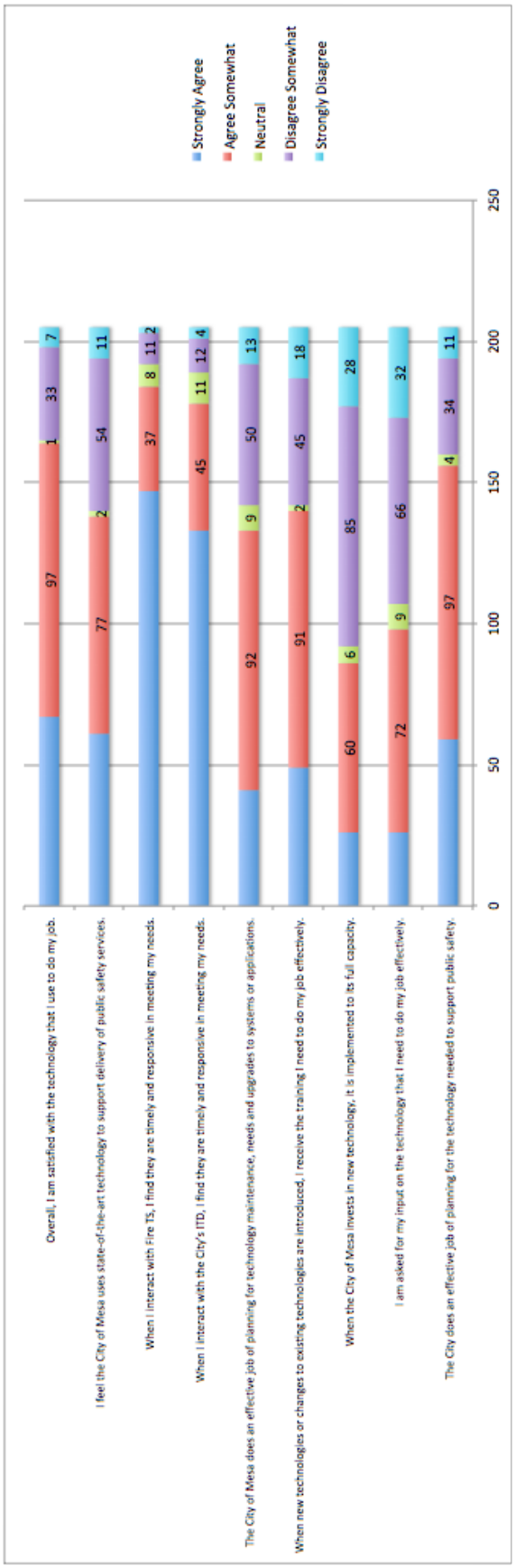

Figure 4. Fire Department survey results.

somewhat and 28 strongly disagreed. Fire department users were more positive about other aspects of technology implementation. The second statement asked, "When new technologies or changes to existing technologies are introduced, I receive a training I need to do my job effectively." 61.4% of respondents strongly agreed (n=49) or agreed (n=91), and 27.63% either disagreed somewhat (n=45) or strongly disagreed (n=18).

Fire personnel were given two statements about City ITD and FD TS customer service. A strong majority of respondents (78.07%) stated they strongly agree (n=133) or agree somewhat (n=45) that the City ITD is timely and responsive to their needs; only 16 disagreed. Likewise, respondents were very positive about FD TS responsiveness with 79.82% agreeing (n=37) or strongly agreeing (n=147); only 13 responded negatively to the statement.

End-users provided several relevant comments in open-ended questions:

- Mesa Public Safety IT does the most they can with the resources available to them. With additional staff and time, new technologies can be implemented to their maximum capabilities rather than just enough to meet the immediate need. Many unmet needs could be satisfied utilizing existing systems if staff was available to work on them.
- My interaction with tech services city, and fire have always been very positive. They are informative, knowledgeable, and polite. I appreciate their hard work on my behalf to make my portion of the job easier.
- Out CAD technicians do a good job in trying to be responsive to Communications, as do our 911 phone technicians.
- Tech services and the help desk to an amazing job keeping the wheels turning

with the system and technology that we currently have! Thank you!

- Overall I think the City does a good job with trying to stay up to date with new ideas and innovations. Technology is obviously very difficult to keep up with. However, I think we could benefit from having more focus on education for the users which in turn would probably mean less work for the IT department since we could troubleshoot issues better on our own.
- The City does a very good job of providing technology to help us with our duties. Some of us struggle with how to use it.
- Hire more CAD/IT techs for fire.

The need for a unified support model emerged from the thematic analysis of key stakeholder interviews. The full summary of the thematic analysis results is provided in Appendix B. Key stakeholders provided a more strategic perspective than end-users, as those interviewed were typically senior managers and administrators. There is a perception among public safety executive staff that City ITD does not respond to ICT issues in a timely manner. From the public safety perspective, there are two user groups, other City users and emergency responders; response times to requests for service should be different for the two user groups. There is also a perception that City ITD is more focused on whether ICT activity can be managed with the right process and resources than on spending time to understand public safety's operational needs; communicating and responding with public safety customers; actual service levels delivered to police or fire customers; or creating user-driven outcomes (the drive to get it done quickly obscures the need to get it done right). Conversely, City ITD staff interviewed felt that public safety do not follow City ITD processes and practices (e.g. document

management, incident management, ticketing) and are not actively involved in working groups.

MFMD stakeholders had specific concerns about the CAD arrangement. The current CAD was designed to work as an integrated police-fire system. Mesa PD is the manager of the CAD and provides ICT support to the MFMD for CAD-related issues. Senior fire officers note that while the MFMD contributes funding for the CAD system, they do not believe it has sufficient control over system configuration or decisions that affect fire department operations. Stakeholders also mentioned that police and fire use CAD differently, which has created support issues. Fire command staff said they do not have direct access to the CAD vendor, rather they have to go through PD ITS for service requests which limits Fire's ability to influence decisions, to probe for possible solutions, or to explore what workarounds might exist in CAD. MFMD is not given access to the servers or network configurations. These problems – among others – provided a theme related to the need for a new ICT governance model.

Question 3. *Is there an adequate planning and research process in place for developing emerging technologies to meet the future ICT needs of the fire department?*

Three statements in the end-user questionnaire were used to solicit opinions on the adequacy of the City's process to plan for and develop emerging technologies for fire department operations. More than 68% of fire department respondents strongly agreed (n=59) or agreed (n=97) with the statement, "The City does an effective job of planning for the technology needed to support public safety." A majority of firefighters (58.33%) also felt that the City does an effective job of planning for technology maintenance, needs and upgrades to systems or applications. But, respondents were evenly split over the

statement, “I am asked for my input on the technology that I need to do my job effectively.” Ninety-eight firefighters agreed with the statement and 98 disagreed. Nine respondents were neutral. However, more respondents strongly disagreed with the statement (n=32) than strongly agreed with it (n=26), suggesting that feelings are stronger among end-users who feel they do not have sufficient input in the technology planning and research process.

Responses to open-ended questions provide additional end-user perceptions on their level of participation in the planning and research process:

- I believe it is beneficial to have the end user participate in trial and error evaluation of a new system or application, prior to its implementation. A good example is KRONOS. When a new system is instituted, effective training to everyone who will be using the program is imperative.
- For new systems that would be implemented, continue to perform trail runs at the end user level to make sure it is effective and helps to make the user’s job easier. We have many different personalities; so make sure many different people get a chance to provide input about what we think.
- More attempts need to be made to consult with the people actually using the technology to determine the functionality. For instance, I don not know how much input was given many years ago to the implementation of the RMS system. However, there were many, many issues at the implementation of the system that could have been addressed with primary users at the beginning more effectively. The system works well, however the people back then who make that decision (chiefs, assistant chiefs, etc.) have no real use for the system and many don’t ever

have an occasion to use it. Primary users should have been consulted not just on the system's functionality, but on the implementation of the system in order to have a more smooth transition at that time.

- Before buying a new application/system, the people who will be using said system should have a chance to test it. If the end result is that the system is not very efficient, the perhaps the city should rethink the purchase of a particular technology.
- Get more input before making changes. Ask end users to help develop technologies.
- The systems we get are always shoved down our throat. Even when the committee wants to see something different someone somewhere has already decided to make the purchase and a purchase on a system they don't have to use. The committee process is a joke, where the City of Mesa tries to act like the employees who use the systems actually helped select them. In reality the City of Mesa already made a purchase and hoped the employees would like the system, but don't.
- I would recommend users be trained to become proficient in the software currently provided by the department. Also to get the end users advice on software needs to work efficiently and continued to elicit input on the program selection.
- Better communication and input.
- End users are not brought into the decision-making process.
- Listen to the employees for their suggestions and comments of current needs.

Who better to ask than those working in the areas in need?

- Talk to the people who are using these systems.
- The City should include end users more in development and selection of technology whenever possible. I feel Fire does a good job, when they can, but lack confidence in City run projects. Especially in the areas of Dispatch, MCT, etc. If PD is involved, I feel the input of Fire end users is disregarded and not seen as relevant.
- In the Fire Dept. individuals are allowed to make technology purchases without any knowledge or investigation in to technology that is already owned many times purchasing something to solve a problem that has already been solved. Technology has been purchased where one person or small group has made the decision without any advice from the people who will be directly impacted and ultimately have to use, maintain, and/or support the technology in question.
- It seems like there is no long-term plan for technological solutions. It appears we buy multiple systems, each meeting a narrow scope of the total solution, instead of a total solutions capable of being upgraded to meet future needs.

Thematic analysis identified a need for a model to conceptualize and develop emerging technologies (Appendix B). Key stakeholders noted that, while each Department did conduct its own research to discover new technologies, there was no formal citywide R&D process in place or dedicated innovations group. Instead, Internet searches, discussions with vendors, conferences and trade shows are used as a way to identify solutions to enhance or establish future operational processes. In addition, senior staff from police and fire felt that they do not have sufficient input during all phases of

technology project management. As a result, some technologies do not meet needs or have an adverse effect on their capacity to carry out their work.

Thematic Analysis of Stakeholder Interviews

Many of the themes identified in the thematic analysis were discussed in the preceding section, however two additional themes emerged from the review. First, key stakeholders confirmed the need for a clearly articulated strategy to improve interdepartmental coordination, guide project prioritization, and to ensure technology projects align with operational plans and initiatives. Currently, public safety does not sufficiently plan pro-actively for technology needed to meet business needs. While some planning for ICT does occur, it was stated that it can be politically and fiscally effective to take advantage of ad hoc opportunities to launch new technological initiatives.

The second theme that emerged was the need for a sustainable ICT cost and funding source. Stakeholders mentioned that lifecycle costs are not adequately considered during the budget process. Software licensing agreements have resulted in significant cost increases to the MFMD. The primary source of funding is from the City's General Fund. Yet, the City does not have detailed information to make informed decisions on ICT investments, nor hold department's accountable for implementation goals.

Discussion

Comments received during interviews and on the questionnaire show that ICT end-users and MFMD staff believe new technology purchased for public safety is not always implemented or configured in a manner that achieves the desired outcome. Stakeholders who are affected by the technology say they are not adequately identified at the start of the project and do not have sufficient input during the specifications

development, product selection, and testing processes. As a result, far too often, technologies either do not meet the need or have some degree of functional issues impacting usability. In addition, many stakeholders believe that ICT service delivery is more focused on whether ICT activities can be managed with the right processes and resources than on spending time to understand public safety's operational needs; communicating and responding to customers; actual service levels delivered to customers; or whether the processes being used are effectively supporting the successful attainment of project outcomes. Much of the literature on ICT planning reviewed for this project (Blavin et al., 2013; IAFC, 2005a; Ward, 1995) stressed the importance of involving end-users in effectively introducing new technologies into the organization.

Similarly, interdepartmental coordination and communication on ICT projects appears fragmented resulting in costly mistakes. One representative example of the issue is that end-users report that they had experienced long-term reliability and availability issues with the video teleconferencing (VTC) and video training systems. A video conferencing test was conducted at Fire Station 213. Participants included FD TS, City ITD, City Communications and MFMD command staff. The test found that video conferencing did not exhibit any issues when tested. Technical staff said this is because the equipment is set to limit bandwidth to function over the T1. When the team tested the ability for users to watch training over the Internet, it took several minutes (about 4 minutes) for the PCs to boot up and log on. Firefighters stated this is their usual experience. Technicians said only one of the eight T1s at the station are being used because they do not have the equipment to aggregate the other seven. When asked the cost of the equipment, City ITD technicians said they believed the cost was about

$5,000. Fire command staff asked for a proposal for alternative solutions, including the equipment to aggregate existing T1, and the cost and benefit they could expect.

In some cases, not all equipment needed to implement the system is purchased up front. Additional hardware and/or software needed to complete the installation are sometimes discovered during the implementation phase of the project. This causes implementation delays and additional unplanned costs. This problem can also be traced to the deficiencies in the specifications development process. Mesa experienced this problem while implementing the VTC and Web-based training systems. The Department was unaware of additional network equipment needed, and City ITD did not advise the MFMD that alternative solutions were available while waiting for a fiber installation. This, too, is likely the result of insufficient interdepartmental coordination on the project.

This study further revealed that many current public safety systems are in need of updating because the City has failed to keep up with vendor software release cycles for major applications. As the lifecycle of a technology evolves, it reaches a point of programmed obsolescence (McEwen, 2011) and begins to experience deteriorating interface connectivity (Jayne, 2012). The best example of this is the state of CAD. Mesa is so far behind that a major upgrade or complete replacement is now needed to meet the end-users' growing needs and to reduce the cost of support from the vendor. In another example, the MFMD uses Firehouse RMS version is 7.11.15, while Firehouse is delivering 7.14. MFMD has no current plan to replace Firehouse, but is considering an upgrade to Firehouse's .net solution. A piecemeal approach to system upgrades is creating compatibility, data integration, and other maintenance issues. This problem is manifest in the ePCR system where data has become difficult to share across platforms or retrieve in a

format that equips the MFMD to make informed decisions. Ultimately this will eventually decrease user satisfaction with the system (Thong et al., 1997).

A key issue is that the City has not developed a Public Safety ICT Strategic Plan that corresponds with the MFMD's strategic plan or the mission and objectives of the organization. This alignment of organizational and technology strategies, with a focus on wider community priorities, has been identified as essential to efficient and effective implementation (Avison et al., 2004; Johnson & Lederer, 2010; NSW Department of Finance and Services, 2011). In fact, there is little evidence that public safety technologies are developed, procured, or implemented through a planned, methodical process. As one end-user wrote in a response to an open-ended question: "It seems like there is no long-term plan for technological solutions. It appears we buy multiple systems, each meeting a narrow scope of the total solution, instead of a total solutions capable of being upgraded to meet future needs." The implication is that discussed by Ward (1995) where the Department is simply adding up a list of projects and buying whatever technology appears to fit without consideration of an overall ICT strategy. City ITD has incorporated some of the planned application upgrades into its five-year technology roadmap to support major public safety systems. But, the lack of a comprehensive public safety technology strategy impacts the fire department operations and City's ability to adequately plan and budget for the impact of this technology in future years. The funding for this technology and its impact on staff, processes, services, and long-term maintenance are not identified until the need for the technology is immediate.

Furthermore, while a majority of survey respondents *feel* the City does an adequate job in planning for the technology needs, there is not a *formal* R&D structure

within any of the City's ICT organizations supporting public safety operations. This fact is reflected in the documents reviewed and comments made during stakeholder interviews. "ICT needs careful planning and coordination prior to implementation and use otherwise trial and error methods of implementation that characterize most government ICT applications will only succeed in wastage of scarce resources" (Gichoya, 2005, p. 177). In their normal course of duty, and to a very limited degree, City ITD, FD TS, and PD ITS staff members are proactive in researching new technologies and solutions to support public safety operations. New public safety technologies are discovered at trade shows, discussions with other jurisdictions, and through independent research. This research does help keep the MFMD abreast of new technologies and methods, but does not provide the same benefits of a formal R&D process.

The MFMD is considering a number of new and emerging technologies to support near-term and strategic operations. These projects include iPhone and Android applications that interface with the public; cloud-based data repositories; a regional network with partnering jurisdictions for training; upgrades to .net-based RMS solutions such as Firehouse.net; the use of tablets and other mobile net-based RMS solutions such as Firehouse.net; the use of tablets and other mobile technologies to support day-to-day operations; and other emerging public safety technologies. These initiatives and investigations are being conducted on an ad hoc basis. Staff members supporting these efforts are not trained researchers, nor are they following a unified approach to determine needs, requirements, cost, platform, interoperability, data format and integration, or a host of other important factors when considering and implementing new technology. The R&D process will become increasingly complex as the NPSBN begins to build out and

technologies purporting to be compatible with that network come to the market.

Recommendations

Public Safety ICT provides a critical tool for protecting lives and property of the citizens of Mesa. The City has demonstrated a commitment to investing in proven cutting-edge technologies for public safety. But, the way these technologies are conceptualized, developed, and implemented has not been strategic. Responsibilities for managing technology initiatives have generally been left to individual city departments, resulting in fragmented planning efforts with limited coordination. The fragmented nature of the current structure means that many that many of the public safety ICT support needs are not being met. Furthermore, the City does not have the information it needs to ensure that public safety ICT investments are cost effective or appropriately implemented.

There are several actions that should be undertaken in the near-term to facilitate coordination and improve existing processes.

- **Develop a comprehensive public safety ICT strategic plan**. The City Manager should lead the effort to develop a detailed strategic plan for public safety ICT. Support from the senior administrator is critical to the success of strategic planning, and given the importance of and significant investments made in public safety technology, this level of attention is justified. The goals of the plan must align ICT initiatives with the strategic plan of the MFMD (and the Mesa Police Department) and the broader goals of the community. The plan should outline proposed public safety technology initiatives over a 5-year planning horizon, but be updated annually.
- **Establish a joint workgroup for technology oversight.** The City Manager should

also establish a senior-level joint workgroup with the Chief Technology Officer, MFMD, Mesa Police Department, and City ITD. One of the workgroup's primary responsibilities would be to develop the citywide public safety ICT strategic plan. The workgroup would also be charged with assessing whether a proposed project is appropriately aligned with the applicable department and citywide public safety ICT strategic plans; analyzing lifecycle costs and prioritizing projects; coordinating cross-cutting ICT initiatives to ensure compatibility and interoperability of systems; monitoring changes in public safety information systems and communications technologies; assessing the long-term impact of changes on the City's public safety systems; and integrating changes into the public safety ICT strategic plan. Partnering jurisdictions should be included in the workgroup to foster strong interagency relationships in the planning process and ensure technology decisions are closely coordinated.

- **Formalize the R&D process.** The Fire Chief should create a formal R&D group within Technical Services and provide training on proper research techniques. A process should be created that provides a consistent way to identify and evaluate emerging technologies. The R&D group would be charged with evaluating new technologies and providing a business case for how a technology maps to current and future operations, the problem it solves, its impact on interoperability and compatibility with existing systems, and the benefits the City will realize from the technology.
- **Establish mechanisms to involve end-users.** There are many different mechanisms for involving end-users in the decision-making process. Possibilities

include involving select users in the oversight committee; forming a user's advisory group; establishing an email box to collect ad hoc suggestions, comments or ideas; and conducting an annual survey to assess needs and performance of technology.

- **Unify technology support services.** When a problem is reported with a technology it should not be categorized as a "police issue" or "fire issue," the focus should be on providing support to the end-user. Providing centralized support services will decrease time to identify and resolve reported problems. A unified approach would also help create common standards and a cohesive service plan for technology support; standardize training throughout the organization; create a holistic approach to problem-solving and remediation; better address compatibility issues across public safety technology platforms; and increase operational efficiencies and decrease costs.
- **Update or replace outdated software and systems.** It is the responsibility of the MFMD to understand the vendor's roadmap and release schedule and to plan and budget for software upgrades. Updates that produce value to the end-user and are deemed essential to service delivery should be implemented immediately. The CAD system is long overdue for replacement. The City should take a regional approach to developing functional and technical requirements for a new CAD system to ensure that all interface and data requirements are considered and to determine the affect a CAD update will have on RMS and mobile applications.

This applied research project describes the current state of public ICT in Mesa and identifies the most problematic issues in planning and implementation. There are several

managerial issues that were not addressed in this project. Efforts are underway to conduct an in-depth analysis of public safety ICT organization, services, and staffing. That project will identify options for reorganizing the City's public safety ICT resources to support the execution of the public safety ICT strategic plan. Once a structure has been selected, a plan must be developed that includes specific actions to be taken, timelines, and responsibilities in the transition. Future research should investigate the personal and workplace antecedents that lead to successful implementation of technology as these may provide additional insights and specific recommendations for action.

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Appendix A

Key Stakeholder Interview Questions

Date:

Location:

Interviewee:

1. Current and Near Future Public Safety Operations Requiring IT Technology Solutions
    a. What current and near future business processes require an IT solution?
2. Current IT Technology Employed
    a. What systems sufficiently support current operations?
    b. What systems do not sufficiently support current operations? What is lacking?
3. Current IT Support for Existing Operations and Systems
    a. How are IT projects for your department currently prioritized?
    b. What are the strengths of the IT processes that are currently in place?
    c. What are the weaknesses of the IT processes that are currently in place?
    d. Is sufficient data available to support your reporting and decision-making efforts? If not, what is needed?
    e. What consideration is given to short and long term support of IT solutions?
    f. What disaster recovery solutions and contingency operation plans are in place?
    g. What concerns do you have regarding enterprise IT solutions and support? (i.e. email, internet, intranet, etc.)
4. Current IT Support Staff and Issues
    a. Who provides your current IT support? (i.e. Internally supported, City IT supported, or both)
    b. How many staff members and in what positions currently support your IT operations?
    c. Is your current IT support staff sufficient? If not, what do you need?
    d. What's your general feeling regarding the current IT support model?
5. Strategic Operations Requiring New or Advanced IT Technology Solutions
    a. What planned, future business processes will require an IT solution that does not exist now?
    b. What current solutions do you foresee being decommissioned?
6. Anticipated IT Support Needs to Support Future IT Solutions
    a. What significant strategic objectives are planned for the future that will require an IT solution? Which are funded or are likely to be funded?
    b. What is the strategic plan for IT services, including long-term support, disaster recovery and contingency operations, to support future needs in your area? Where is the plan documented?

    c. What additional data do you envision needing for future reporting and decision-making?
7. Anticipated IT Support Staff and Anticipated Issues to Support Future Needs
    a. How will future departmental IT projects be prioritized?
    b. How will you staff future IT projects and on going IT support for those projects?
    c. What future concerns are there regarding enterprise IT solutions and support (i.e. email, internet, intranet, etc.)?
8. The "Ideal" IT Support Model
    a. What IT support model best supports your department's IT needs? What IT support model best supports the City's needs as a whole?
    b. What "quick hits" can be made to improve the current IT support services?
    c. If you could change one thing about your current IT support model, what would it be?
9. Your Additional Comments

Appendix B

Stakeholder Comments Categorized by Theme

Need for a clearly articulated strategy

The vision for City ITD includes focusing on innovation, standardization and efficiency.

MFMD would like to see an adjustment to the City's philosophy for ICT service delivery, where end users and results primarily drive the focus (instead of ITD staff and business process), with the impact on citizens at the forefront when ICT decisions and investments are made.

City ITD prepares an eight-year roadmap articulating the vision for IT needs and corresponding investments to inform the City Council's decision making. Public Safety is involved in network and server planning needs, but PD ITS does not include the PD ITS projects they solely manage in the Roadmap.

City ITD meets with Mesa's Department Directors and uses the data collected to develop the City ITD budget request; via this approach, both City ITD and the respective Department are aware of what information will be presented to the City Council by either party.

City ITD, PD and MFMD leadership do not communicate effectively in budget or IT planning processes.

PD and MFMD TS do not sufficiently plan proactively for technology needed to meet business needs and for the resources/staff needed to perform the work (e.g., strategy vs. commodity skills).

While some IT forward planning occurs by PD and MFMD, it can be politically and fiscally effective to take advantage of ad hoc opportunities to launch new operational and technology initiatives.

It appears that MFMD technology projects are largely driven by opportunity (e.g., incident, circumstance) rather than strategic planning; it is not clear how much strategic effort is placed on technology to support long---term operational goals and objectives.

The Public Safety IT Strategic Plan should provide for a well thought out case for Public Safety IT needs while allowing PD and MFMD to capitalize on opportunities that they

cannot effectively plan for.

Need for a sustainable ICT cost and funding model

City ITD reports that Operations and Maintenance funds are its primary source of funds. City ITD CIP funds are imbedded in departmental projects. City ITD staff members do not think an IT bond would pass where public safety bonds do.

The City ITD budget is approximately $29M. Monies for application development typically reside in the respective Department's budget.

Infrastructure and application needs can be funded through the City's General Fund or monies can be included in a Public Safety bond resolution.

Historically, the City has not had detailed information to inform and defend the IT requests it places for Public Safety in the CIP.

City ITD transitioned software licensing from a per-station (i.e., computer) to a per-person cost. This resulted in significant cost increases for MFMD.

MFMD TS funds come from CIP/Bond and Operations and Maintenance funding. Some grant funding is also used.

Public safety IT lifecycle costs are not considered within the City ITD budget process, but City ITD does pay for some maintenance on MFMD systems.

More planning is needed so procurement does not impact schedules. The procurement process is arduous for low cost solutions.

Need for a unified support model

There is a perception that senior City executives do not give sufficient attention to public safety executive and senior staff input regarding need for specific technology-based solutions, nor do they place sufficient emphasis on user-driven outcomes.

City ITD feels that PD and MFMD do not follow City ITD processes and practices (e.g., document management, incident management, ticketing) and are not active in participating in working groups. Conversely, City ITD is perceived by Police and Fire as overly process and policy- driven, which may impede the outcome of the project or effort.

City ITD sees MFMD as one of many departments they support.

City ITD support for MFMD operations is lacking in that City ITD staff members do not sufficiently understand MFMD operations, nor are efforts being made to improve the business knowledge of City ITD staff.

MFMD TS states it knows of a few contacts within City ITD, but does not have a list of whom to call for what issue.

MFMD also dispatches for Gilbert, Queen County, Apache Junction, and Rio Verde; IT decisions have an effect beyond Mesa's geographical boundaries.

While MFMD contributes funding for the CAD system, MFMD leadership does not believe it has sufficient control over system direction or decisions that affect MFMD operations.

Communications are between PD and the CAD vendor (Intergraph); MFMD receives yes/no updates from PD on whether requests can be fulfilled, and thus is unable to influence the discussion or probe as to what is possible or what workarounds might exist within CAD.

CAD use is different between PD and MFMD which creates support issues, including CAD configuration. MFMD does not have access to all CAD servers and network configurations. The entity relationship (ER) diagram for CAD is proprietary to the vendor. The CAD Help file (CHM) would provide insights into the data and interface relationships.

The current CAD system was designed to work as an integrated system. Mesa is running two configurations currently. PD and MFMD have unique event codes. The MFMD CAD Tech, with MFMD supervisory approval, can make changes to CAD (e.g., add an event code), provided the changes do not interfere with PD Communications operations or have an adverse effect on overall CAD system operation. Changes are not logged through a formal change control process, thus there is no method (other than audit logs for last '#' of modifications) for tracking updates and modifications, or examining trends.

There is a contract for third party hosting of EMS data. Sansio (vendor) provides MFMD with an xml file of the hosted data from which City ITD can prepare custom reporting; City ITD support is needed for programming resources/skills.

The problem resolution process for MFMD end user support follows the City ITD

process for all Departments. Calls are reported to x2363, Option 3 and handled by a COM HD Engineer. Desktop issues are sub---tasked to MFMD's Technical Services (FTS) HD for resolution. Desktop issues may be escalated back to City ITD when the issue is identified by FTS HD as server, network or application support related. Application issues are routed from COM HD to FTS to the MFMD TS staff. When the issue is resolved, MFMD TS staff contacts FTS to close the ticket. If MFMD identifies a system problem internally, they create the IR ticket in SMART and assign themselves the incident, work it (unless escalation is required), and notify the customer of resolution.

MFMD TS states it uses SMART to log incidents. There are no formal, documented processes followed to resolve incidents reported. There are no training or user's manuals for SMART. Fire has asked for training, but none has been provided to date.

Fire has a flow chart for battalion chief's to determine whom to call when for problems. There is no formal flow chart for MFMD TS technicians to use to solve a reported incident.

MFMD TS states Fire users are often told by City ITD help desk staff to call MFMD TS directly for their issues. MFMD TS states users do not see City ITD as an actual 7X24 service provider.

MFMD TS states that City ITD makes changes to SMART without notifying MFMD TS. Case in point is a recent change to the default criticality code from moderate to critical. When MFMD TS asked why the change was made, City ITD stated the help desk wanted the change. Most Fire incidents are moderate, which causes MFMD TS to have to change the criticality code for most entries.

There is the perception that City ITD is more focused on whether IT activity can be managed with the right processes and resources than on:

- Spending the time to understand Public Safety's operational needs
- Communicating and responding with public safety customers
- Actual service levels delivered to public safety customers
- Outcomes achieved; the drive to get it done quickly obscures the need to get it done right

Need for new ICT governance

Deputy City Managers believe that there is a great deal of inefficiency resulting from the current structure, and that the City's overarching Public Safety IT support needs are not being met effectively.

From the City's perspective, the question is whether PD ITS's structure should remain unchanged, focus primarily on applications that directly support operations, or become part of City ITD.

PS needs a unified IT command structure.

There needs to be a consistent governance and management structure for technology functions.

There is not a formal unit with resources dedicated to innovation/emerging technologies.

City ITD has an embedded procurement unit that handles IT acquisitions from requirements definition through contract award.

The MFMD TS staff is not formally organized into a separate unit, but is part of the MFMD Technical Services unit.

MFMD TS staff needs to interface with too many City ITD resources to get the full range of support (e.g., Application, help desk, network).

Public Safety believes that it is not sufficiently consulted regarding unique operational constraints prior to the City making investments in enterprise solutions. From the PD perspective, City ITD does not sufficiently understand Public Safety operations to proceed without obtaining input; selections may be a poor fit for Public Safety that additional systems training will not solve.

City ITD and PD ITS do not solicit or consider MFMD TS's input during the requirements stage of an effort.

City ITD help desk staff is impersonal and lacks the skills to effectively route the issue reported by MFMD.

City ITD and PD ITS do not know nor do they understand MFMD operations and the implications to systems used by MFMD.

Information security is a stumbling block for MFMD TS to have access to systems and information they need to troubleshoot an issue.

PD ITS feels MFMD wants the Mesa CAD to function like Phoenix Fire's CAD but

they are two different systems from two different vendors.

MFMD TS and users are not asked for input from City ITD on enterprise projects.

The CAD Steering Group could benefit from a CAD PM to ensure adequate follow---up on issues that are raised. More broadly, having an 'action officer' responsible for reporting back on open items could enhance accountability for implementing decisions or closing out follow-up items. (PDITV)

The Deputy City Manager is effective in building consensus during CAD Steering Group meetings, but could be more definitive in making decisions when there is lack of agreement or conflicting priorities.

Communication between City ITD, PD and MFMD needs to be more collaborative.

MFMD TS states the Communications User Group is for Police only and Fire is not invited to the group. The discussions are about radio and CAD issues. Fire needs a voice in this group.

MFMD believes that communications with PD about CAD is difficult. There is limited communications regarding mapping, which causes map development issues. Map users do not agree on naming conventions and other global issues.

MFMD TS believes PD ITS and City ITD do not understand the importance of supporting other jurisdictions under contract with Mesa nor do they understand quality customer service in general.

PD ITS feels they need to meet with command staff periodically to help the command staff understand what they do and the issues they face followed by routine meetings to discuss priorities and progress.

MFMD TS states PD ITS is only concerned with PD systems and does not look at things from MFMD or the City's public safety obligations.

Need improved communications to get problems resolved.

Need for a model to conceptualize and develop emerging technologies

City ITD does not have a formal Research and Development (R&D) group. Each Department does its own research.

Although City ITD does not have a dedicated innovation group, they are exploring the implications of mobile devices (e.g., smart phones, tablets) and alternative operating systems (e.g., OS X, i06, Android).

Firehouse is moving to a .net Web-based platform which, if adopted, will require a change in MFMD processes and require funding.

A regional network to partnering MFMD jurisdictions is required to support training and operations.

Staff is using their personal phones and iPads to support their work; it is not clear if Bring Your Own Devices (BYOD) policies are in place to cover these circumstances.

The City has a mobile device management policy that all employees receive and sign during orientation. PD and MFMD do not maintain separate BYOD policies, but refer their employees to the City's policy. Mesa360 is the City-wide software for managing mobile devices. Access is provided to calendar, mail and contacts. City employees (excluding PD and MFMD) receive a $30-$40 per month stipend to fund their personal smartphone or tablet devices (no limitations on manufacturer of device). About 75-85% of City ITD employees participate in the program.

MFMD TS states the policy for personal device use is a Citywide policy, but it is not sufficiently covered during employee indoctrination. Firefighters use their own devices for Internet access on calls to view maps, HAZMAT information and other helpful information on the call.

Internet research, vendor discussions, conferences and technology shows are used as a way to identify solutions that will enhance current or establish future operational processes. There is no R&D effort.

Frontline staffs do not believe they have sufficient input during the requirements phase of projects. As a result, technology changes either do not meet their needs or have an adverse effect on their capacity to carry out the work.

City ITD states it will manage as many MFMD TS projects as they have approved.

MFMD TS states City ITD only manages one MFMD TS project at a time even though more may be approved.

City ITD does not believe the MFMD does an effective job of prioritizing concepts for

projects (i.e., ideas), of scoping projects, or bringing them to conclusion. MFMD may have 30 projects ongoing at any time. A lack of alignment between the requirements of the work and staff capabilities results in standard IT practices and processes not being implemented.

The East and West Valley Radio System project did not have sufficient operational representation to ensure end user needs were captured and considered, which has resulted in IT driving a solution.

CAD as currently configured has limitations for capturing MFMD data. For example, coding for deployment of resources is limited to four response choices. Also, CAD response options limit data richness (e.g., for trauma, only blunt force is an option for selection). Another example was provided contrasting event types for Phoenix (122) and Mesa (20).

Fire's requests for changes to the nature/event codes in CAD go to the LT in PD Admin staff. Fire dispatch was told there would be no more code changes because of the impact to call taking operations. (MFMDITV)

MFMD operations needs a map update every 30 days to reflect recent changes that affect MFMD response and operations.

- The City takes nine months to create a map.
- Call Takers expect to see the same map features pre--- and post---map update.
- The database of commonplace names, currently controlled by PD, is not sufficient for MFMD purposes.
- MFMD staff will use their iPhones for mapping needs because they are not comfortable with current CAD routing/AVL capabilities.
- MFMD staff wants to view the region, while PD staff wants to only view Mesa.
- GIS Mapping for CAD

MFMD does not plan proactively for its data needs or for how it expects to use predictive analytics. This results in a series of disparate systems that do not communicate with each other.

Collection and reporting within or across systems is difficult. Information has proven to be inconsistent between systems.

The CAD and other systems supporting MFMD operations are not configured to provide information at a level of detail (e.g., by station, by shift) needed to support

operational decision---making.

MFMD staff does not have the tools or access (particularly to CAD data) to mine and report information to support informed business decisions or for analysis to make process improvements.

MFMD reporting is ad hoc and fragmented. Systems are not appropriately interfaced, and so it frequently requires one-off programming to develop needed reports.

MFMD staff has great difficulty extracting data from divergent systems for ad hoc and routine reporting.

MFMD chose Sansio Health EMS for its e-PCRS. The decision to forego the Firehouse application meant that MFMD's applications are not natively integrated.

The network to the fire stations supporting MFMD operations is not maintained to the degree desired. There are too many network and bandwidth-related issues to adequately support MFMD operations.