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DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP RESEARCH REPORT 182

Guidance for Planning, Design, and Operations of Airport Communications Centers

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AIRPORT COOPERATIVE RESEARCH PROGRAM

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Once selected, each ACRP project is assigned to an expert panel appointed by TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

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FOREWORD

By Marci A. Greenberger
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Various functions occur at an airport communications center. Typical functions include dispatch of police, emergency response, maintenance requests, and monitoring of airport systems (e.g., CCTV and access control). In some cases, individual departments have "siloed" these functions into separate call centers. Myriad factors need to be addressed in considering the best approach to providing necessary services internally and to the public. *ACRP Research Report 182: Guidance for Planning, Design, and Operations of Airport Communications Centers* provides guidance in considering such factors.

At airports, communications centers are known by different names, such as integrated communications centers or airport response coordinated centers. However, their functions are similar in that they allow the elimination of separate "siloed" call centers run by individual departments. Integrating the handling of several functions into one communications center can achieve operational efficiencies.

With more and more technology requiring monitoring by staff and thus diverting their attention, there is concern about staff maintaining situational awareness. No one solution fits all airports. Various factors need to be considered in determining whether an airport should have one integrated communications center or individual call centers for each department.

Burns Engineering, in support of ACRP Project 10-20A, was selected to conduct research of airports and other entities with integrated communications centers and then develop guidance that can be used by all sizes of airports to determine which type of airport communications center best meets each airport's operational needs. This guidance will be useful to airport planners, operations staff, engineers and architects, and IT staff.

CONTENTS

Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

SUMMARY

Guidance for Planning, Design, and Operations of Airport Communications Centers

Information to make sound, accurate, and timely decisions is an absolute necessity in the modern airport environment. The data blocks, which form the basis for this information, flow throughout the airport through numerous internal and external communication channels, often in a non-integrated fashion, resulting in airport management not being able to gain the situational awareness necessary to make sound day-to-day decisions and plan for strategic airport initiatives. Furthermore, with the proliferation of new technology, applications, and systems, the amount of data flowing throughout the airport keeps expanding. Simply stated, the more complex the airport environment, the greater the amount of data in transit and the greater the need for a communications center.

In response to these issues and trends, more airport operators are developing airport communications centers (ACCs) where airports can

- Channel some or all of these communications
- Locate traditionally separate functions so as to increase internal collaboration
- Integrate technology to provide a common operating picture
- Articulate a uniform and comprehensive image to the public, local community, and relevant government entities.

An airport operator can choose from among many models to create an ACC best suited to meet its needs—there is no "one-size-fits-all" solution that an airport can adopt. However, this choice does not need to be a daunting task. Most airport operators are well aware of their operational environment, information needs, and desired operational environment and can plan and design situation-specific ACCs using common airport project management practices and collaboration techniques without the need for substantial outside assistance. The primary inhibitor to developing an ACC solely internally is typically the resources necessary to engage in a potentially extensive process.

Developing a communications center enables airport management to take a holistic view of the entire operation, including processes and procedures, formal and informal communication processes, and electronic and paper information systems. This approach can be valuable for an airport operator when defining its future course of action for the communications center and beyond.

During the ACC project, the following six questions are asked and answered.

WHY? Or the Basis for ACC Development

Determining the reasons for creating or expanding an ACC is probably the most important assessment an airport operator can make. The reasons help answer subsequent questions. For example, does the airport operator perceive a need based on past issues want to better manage a planned airport expansion and/or future growth? Do regulatory requirements need to be addressed, or is creating or expanding an ACC simply an opportunity to have better situational awareness on which to make operational decisions?

"Why" is first discussed in the project charter (Section 3) and then clarified in the Concept of Operations (CONOPS) in Section 4.

WHAT? Or Functionality

Asking "what?" seeks to identify the depth and breadth of functionality the ACC must accommodate to meet the needs of the airport. This description of desired functionality is often expressed in a mission statement and may include items such as

- What array of services is the facility expected to offer?
- What information does the airport operator believe is necessary for obtaining the situational awareness it is seeking?
- What are the potential constraints on developing an ACC?
- What are measurements for success in the ACC effort?
- What functionality should we add to our existing ACC?

The "what" question is addressed in CONOPS (Section 4).

WHO? Or Stakeholders

The first "who" addresses the identity of stakeholders—individual or organizational, internal and external—who will play key roles in the operation of the communication center. This topic is addressed in the CONOPS (Section 4). The second "who" relates to the staff and/or contractors who will actually design, develop, and implement the ACC. This topic is addressed in the project management plan, Resource Management document (Section 3).

WHEN? Or Project Schedule

The timing of the development of an ACC may be contingent on other airport projects, or development may be a standalone project. A clear projection for completion that is flexible enough to allow full testing and training and ensure that any support applications are fully ready for integration into the ACC based on the desired opening is essential. This question is addressed in the project management plan, Schedule Timeline (Section 3).

WHERE? Or Location and Installed Physical Components

The answer to "where" depends on whether the ACC is going to be (1) a newly constructed facility or (2) incorporated into an existing structure. To answer this question, many factors must be considered in the ACC Design Document (Section 5). A secondary "where" question is the location of the backup facility (which is necessary in case the primary ACC experiences a catastrophic failure).

HOW? Or Development Method

"How?" is a multipart question that begins to address how the facility can be successfully developed and implemented based on the information developed throughout the CONOPS process. This question addresses issues such as funding, personnel, integration of existing and planned infrastructure, architectural constraints, coordination of planning and design concerns, and other locally unique activities and assets to be accommodated for the project to move forward. "How" is primarily addressed in the project management plan (Section 3) but it is also discussed in the ACC Design Document (Section 5).

The preceding six questions can be used to develop a new ACC or to revisit the purpose and functionality of an existing center. In fact, these questions should be used as a basis for periodically reviewing the ACC throughout its lifecycle. Perhaps more than any other airport organization, an ACC must adapt to ever-changing internal and external environments, budgetary factors, staffing considerations, and complex risk and operational concerns. Through periodic reassessment, the airport operator can be confident that its ACC is relevant and operating at the greatest effectiveness possible.

Purpose of the Guidebook

This Guidebook has been developed to support an airport operator in this effort by providing an outline of a process for determining the best "model" for its own ACC, and guidance for planning, designing, and operating an ACC. The guidance offered is comprehensive and may be more than necessary for small or mid-sized airports. However, even for a smaller ACC effort or the expansion of an existing center, this detailed view of an ACC approach can provide readers with ideas they can adapt to their own scale and use.

With the above six questions in mind, the Guidebook examines the lifecycle of an integrated ACC, including the concept design, planning, construction and activation, and maintenance and operation of the center. The Guidebook also addresses issues such as

- Developing management support
- Determining center functionality
- Factors for employing single-, hybrid-, or multi-function centers
- Strategies for obtaining stakeholder engagement in establishing an ACC
- Integrating the combined operations, including supervisory structure
- Siting and location for an ACC (including threat and vulnerability assessment)
- Layout and design considerations, including minimum and maximum staffing capacity and ergonometric concerns
- Systems and technology selection and support
- Gaining and maintaining situational awareness
- Data management and data security requirements
- Effect of external entities on ACC operations
- Redundancy and backup planning
- Activation of the ACC and functional transition

This Guidebook also includes

- A section on project management for planning, designing, and implementing an ACC
- A list of external resources
- A glossary of acronyms and definitions.

A Formal Approach to Developing an ACC

This Guidebook strongly recommends the creation of two documents: a project management plan and a Concept of Operations (CONOPS).

The project management plan is used to manage the overall project, including scheduling and budgeting. Although a project management plan for an ACC is no different than that for any other project, the airport operator should choose a team leader for the ACC project who is knowledgeable in project management techniques. Developing a project management plan helps to ensure that the project stays on track and meets the intended organizational goals.

The CONOPS presents a picture of how the ACC will operate, the functions it will include, and the overall goals and objectives for the Center. The formal definition of a CONOPS is a document outlining the characteristics of a proposed organization, function, or system from the viewpoint of the stakeholders who will use that organization, function, or system. It is used to communicate the quantitative and qualitative characteristics to all stakeholders. A CONOPS evolves from an organizationally derived concept statement based on the specific environment and is a description of how a set of capabilities may be used to achieve desired objectives.

This Guidebook also includes information on the basic attributes for defining and implementing a CONOPS and includes airport-related guidance on the following:

- Obtaining Management Sponsorship
- Identifying Airport Stakeholders
- Identifying ACC Objectives and Goals
- Analyzing Information Needs
- Identifying Sources and Systems Necessary to Generate the Required Information
- Establishing Operating Priorities and Processes
- Managing Internal and External Expectations

Figure S-1 illustrates the relationship between the project management plan and the CONOPS. The decision to consider developing an ACC is the first step. Once that commitment is made by airport management, a formal (or even informal) project charter (1a), which identifies the responsible project manager and airport personnel, and the general statement

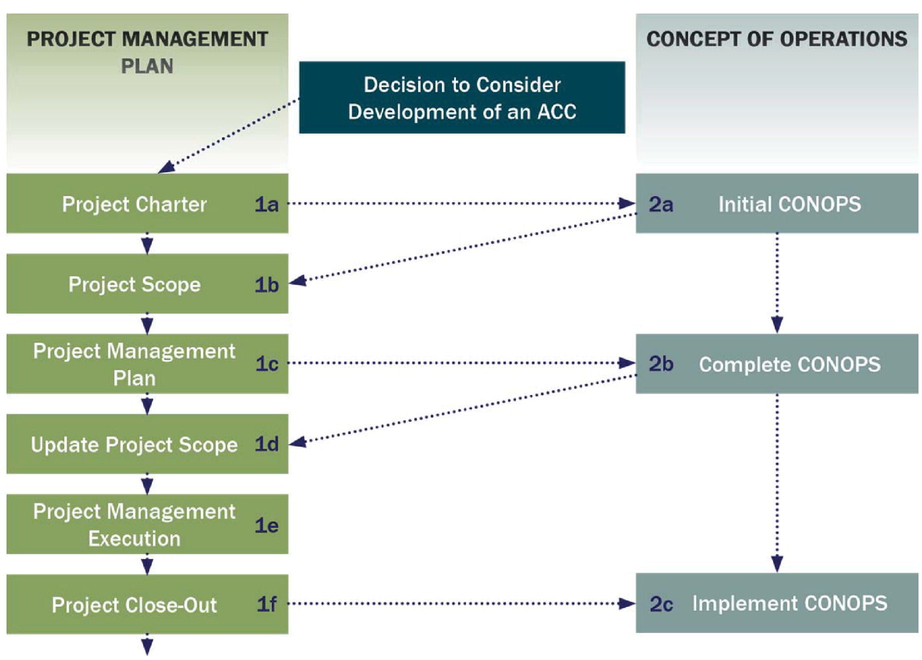

Figure S-1. The relationship between the project management plan and the CONOPS.

of intent is created and approved. It has been said, "If you don't *authorize* a project, you don't have a project."

The next task is to develop the initial CONOPS (2a), which provides a basic outline of the initial set of functions being considered for the center. With the initial CONOPS in hand, the project team develops a more detailed project scope (1b) and a project management plan (1c) for the full design and implementation of the ACC. A crucial element of planning is establishing the total scope of the project. Although it may appear as though that was accomplished while creating the Charter, the scope was defined there at a high level. Here, through iterative and more detailed planning—progressive elaboration (discussed below), project documents are developed at a much more detailed level.

The first major step in the project management plan is the finalization of the CONOPS (2b). Although the attempt is to create as complete a CONOPS as possible, the reality is that both the CONOPS and the project management plan will evolve throughout the life of the ACC initiative. The Project Management Institute's *Project Management Body of Knowledge* uses the term "progressive elaboration," which is defined "as allowing a project management team to manage the project to a greater level of detail as it evolves. It involves continuously improving a plan as more detail, specific information and accurate estimates become available."[1]

The challenge for the airport team implementing the ACC is to find the right level of elaboration. Too much elaboration could mean a poorly defined Project Plan and CONOPS and result in time-consuming and costly scope-creep. Too little elaboration could result in an unsatisfactory product that does not meet the needs of airport management.

Once a completed CONOPS is prepared, the project scope is updated (1d) to reflect the changes to the CONOPS and the Execution of the Project Management Plan (1e) begins. Most tasks are completed in this phase, including physical construction/renovation of the ACC, selection and installation of equipment, developing policies, system implementation, and training.

The process ends with the Closeout of the project management plan (1f), indicating that all necessary tasks have been completed and the ACC is ready to undertake the CONOPS (2c).

[1]Project Management Institute, Project Management Body of Knowledge

SECTION 1

Introduction

The most important asset existing within an airport is the data the airport generates during daily operations. This data, generated by hundreds of separate operational functions throughout the airport, forms the basis for an information flow that can provide airport management with the situational awareness, trends, and historical background needed so as to make sound daily and strategic decisions. The challenge is communicating all of this dynamic, often disparate, data, to a central point in a form that can be translated into a concise and cohesive picture and then using that information for decisions and outgoing communications.

The range of communication channels in a modern airport seems endless. Call centers communicating with passengers, tenants, and the public; visual images transmitted over closed-circuit television (CCTV) systems; signals sent from physical access control systems; radio and voice communication with law enforcement and airport staff; social media feeds; computer-aided dispatch (CAD) systems and emergency messaging systems; email; video, and audio conferencing; and personal interactions are just a few of the systems that make up the modern airport technology and communication environment.

Airports are increasingly seeing the need to implement a single point of control where functional execution takes place and the data resulting from that execution is made available in a manner which can be shared with other airport functions and, especially, with airport decision-makers at every level. That single point of contact is often referred to as an airport communications center (ACC). These centers may also be referred to as airport coordination centers, airport operations centers, and airport resource coordination centers. Regardless of the name assigned, such entities strive to house both critical and non-critical airport functions in a manner which facilitates communication and information sharing throughout the organization.

This Guidebook has been developed to assist airports, of all sizes, in determining if an ACC would bring value to their unique operational environments and, if so, how best to approach the planning design, implementation, and operation of a Center. For airport operators who have already developed an ACC, or some variation of a communications center, this Guidebook may offer some insight on how best to improve, maintain, and even expand the current operation.

This Guidebook provides a set of guidelines, tools, resources, and supporting information necessary for an airport operator to plan, design, and operate an ACC. Developing an ACC involves a range of activities and tasks necessary to define technical and functional requirements, facility location, support, operations, and other aspects. The tasks and activities for each specific airport will be determined by local conditions, organizational goals, funding, and other factors. The information and guidelines in this document will supplement the capabilities present in the airport organization with industry-tested experience and tools, to assist the airport operator in achieving a carefully conceived and well-designed facility.

Although the operational details of an ACC can be complex, planning and designing the facility is based on commonly used project management and analysis techniques used in many other aspects of airport management.

The first task is the creation of a project team responsible for developing and implementing the ACC, followed by the initial development of a Concept of Operations, or CONOPS. The CONOPS is a document that presents a high-level statement of the purpose and goals of the ACC, as determined by the facility's stakeholders and users. This document becomes the guide for all future decisions and direction. An ACC can be built without a CONOPS, but the likelihood of completing a successful ACC project goes up considerably with the use of a CONOPS.

A CONOPS may indicate numerous options, configurations, and functions as appropriate for an ACC. There is no "one-size-fits-most" solution. Through careful identification of the objectives and outcomes the airport operator wants to achieve, the best approach and optimal solution can be chosen.

1.1 Definition of an ACC

For this Guidebook, an ACC is a central physical location in an airport where one or multiple internal (and potentially external) organizations work together to develop a comprehensive picture of one, many, or all aspects of airport operations. The ACC gathers data from various sources using various methods and produces information to portray an accurate picture of airport conditions on which informed management decisions can be made. The ACC is an integral focal point for airport operation through normal conditions, irregular operations, and emergency situations. (The one exception to this definition—where an airport operator may want to create a "virtual" communications center where there is no specific physical location—is discussed later in this Guidebook.)

1.2 Guidebook Structure

The purpose of this Guidebook is to give airport operators the tools needed to consider, plan, design, implement, and operate ACCs.

Section 1 outlines the basic foundation for the need of an ACC, identifies important terminology, suggests an approach for ACC design based on the development of a project management plan and a CONOPS, and identifies some basic structural considerations of an ACC.

Section 2 lists organizational components and considerations which may or may not be included in an airport's ACC, but which should be considered before making a final decision on the scope of the ACC functionality. These components will help to frame the direction of the CONOPS and its effect on the project management plan.

Section 3 outlines the basic steps for developing a project management team responsible for successfully implementing the ACC initiative. This Section includes recommendations on selecting a project team, basic project management artifacts, planning scheduling, and project risk.

Section 4 delves into the CONOPS approach and its importance and role in determining a future course of action, as well as the steps an airport operator should take to develop a relevant CONOPS for their environment. Section 4 also discusses the importance of situational awareness in a communications center and how an airport operator can seek to achieve operational intelligence.

Section 5 outlines the steps an airport operator will take as it considers the physical design of its ACC. The section explores the planning approach necessary to making critical design decisions about physical infrastructure, layout, human factors, ergonomics, and other critical design features.

Section 6 provides guidance for managing the construction of a new ACC, where appropriate, and for commissioning and pre-opening activities that will reduce risk and increase the chances for a successful launch.

Section 7 outlines the approach to determining, selecting, and integrating the technology wanted for the ACC. Given that an ACC is basically a node in a complex technology environment, identifying, procuring, integrating, and operating ACC technology is the most critical step in a successful ACC.

Section 8 outlines best practices for ongoing operations of an ACC and how best to maintain and continually improve communication, data flow, and information sharing.

Section 9 summarizes the best practices and recommendations for an airport operator to consider as it defines, implements, and operates an ACC.

1.3 Role of an ACC

Airports strive to operate in the safest, most efficient, and most effective manner possible. Accomplishing this depends on creating an environment in which information can be shared, assimilated, and used quickly and efficiently to support proper decision-making and assignment of resources for both day-to-day operations and for irregular events. The sheer physical size and complexity of airport campuses and operations, however, make simple, direct, person-to-person communications increasingly difficult.

The objective of an ACC is to provide a facility and/or environment in which mission-critical information, both visual and audible, is delivered to a central point in the shortest possible time and with a high level of accuracy. With support from technology-based tools and solutions, the ACC acts as a data integrator, connecting different information sources and people so that they can operate in a more fully informed manner. The role and function of the ACC may also provide a command and control or decision-making structure from which airport management decisions are made.

As much of this Guidebook suggests, the role of the ACC and corresponding communication needs—and thereby ACC configurations and functions—will likely differ from airport to airport. Determining the role of the ACC at a specific airport and the tools required begins with an assessment that rationalizes choices and design decisions. In undertaking this process, the airport management team should address the following questions:

- What goals are we trying to achieve?
- What are the internal and external influences that govern the need for better communication?
- What critical information must be generated to provide airport management with situational awareness of airport conditions?
- What is the source of the data that will be used to generate the necessary information?
- Which organizations need the generated information and for what purposes?
- If an ACC is chosen as a solution to address these questions, what organizational changes must occur, if any, to accommodate this new business process and focus?
- If an ACC is chosen as a solution, what resources will be made available to achieve the desired outcome (in terms of funding, physical space, and human resources)?
- Finally, what metrics may be used to determine if a successful outcome has been achieved?

1.4 User/Function Focus

Within the airport community, communications centers have been configured in many different ways to support each airport's own operational approach. However, even with the seemingly endless variety of airport configurations, certain operational functions are shared by all airports. A few examples of the most common uses of an ACC are as follows:

- **Airfield operations** can effectively assess airfield conditions, control gates, direct aircraft movement in ramp areas on the Airport Operations Area (AOA), and monitor aircraft servicing operations.
- **Landside operations** can assess the status of terminal conditions, monitor passenger flow through security and public areas, coordinate repairs and maintenance, and manage parking lot operations and traffic operations at the terminal front and approaching roadways.
- **Security and public safety** can (1) control police and security dispatch, access control, video surveillance, and alarm monitoring, and Aircraft Rescue and Fire Fighting (ARFF) and medical dispatch and (2) coordinates with local public safety resources.
- **Emergency services** can provide oversight and support for an incident or an event involving the airport or in support of an Emergency Operation Center (EOC) as part of the Incident Command System.
- **Facilities management** can use the ACC as an intake mechanism for work orders and maintenance requests and coordinate these activities with other airport functions.

An ACC can be configured to support one, some, or all of these functions, depending on the operational requirements and approach preferred by the airport operator. Further, the range of users may include other airport organizations not normally involved with daily airport operational decision-making, such as public and media relations, community relations, concessions and business management, federal agencies, the local community, and public officials. The ACC may also include various functions, outside of core airport operations, such as traffic and parking management, lost-and-found, paging and passenger locator assistance, general airline information, tenant communications, and passenger satisfaction and customer relation activities.

Though not as common, the ACC may also house the airport's technology help desk, network operations center (NOC), and security operations center (SOC). As technology becomes the primary tool for virtually all airport activity, having these essential technology components co-located will be beneficial.

Figures 1-1 through 1-3 illustrate different dimensions of an ACC. Figure 1-1 identifies some of the many groups which may be found participating in an ACC. Figure 1-2 depicts common functions that may be included in an ACC. Determining which functions are best integrated using a hierarchy of operational priorities is best achieved by developing a CONOPS.

Figure 1-3 illustrates how communications systems need to be scalable to support both daily operations and irregular operations of emergency situations.

Most airports face the task of collecting, coordinating, and communicating information within the airport environment and with external government and support agencies. This situation has created an increased emphasis on satisfying growing communication demands, heightened regulatory requirements and security procedures, and more sophisticated information technology (IT) systems to effectively and efficiently coordinate diverse entities. Because the communications process has a direct relationship with, and effect on, the efficient operation of airside and landside facilities, any terminal planning and design must consider the interaction of communications systems with all major airport and community components and services.

Figure 1-1. Common airport operations/ public safety communications/command and control center.

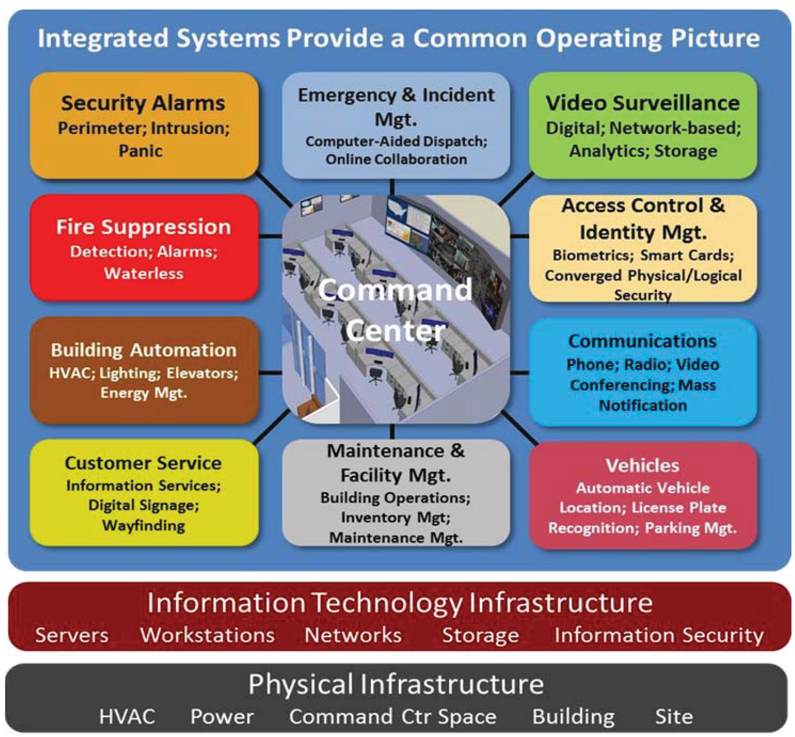

Figure 1-2. Information technology infrastructure/physical infrastructure.

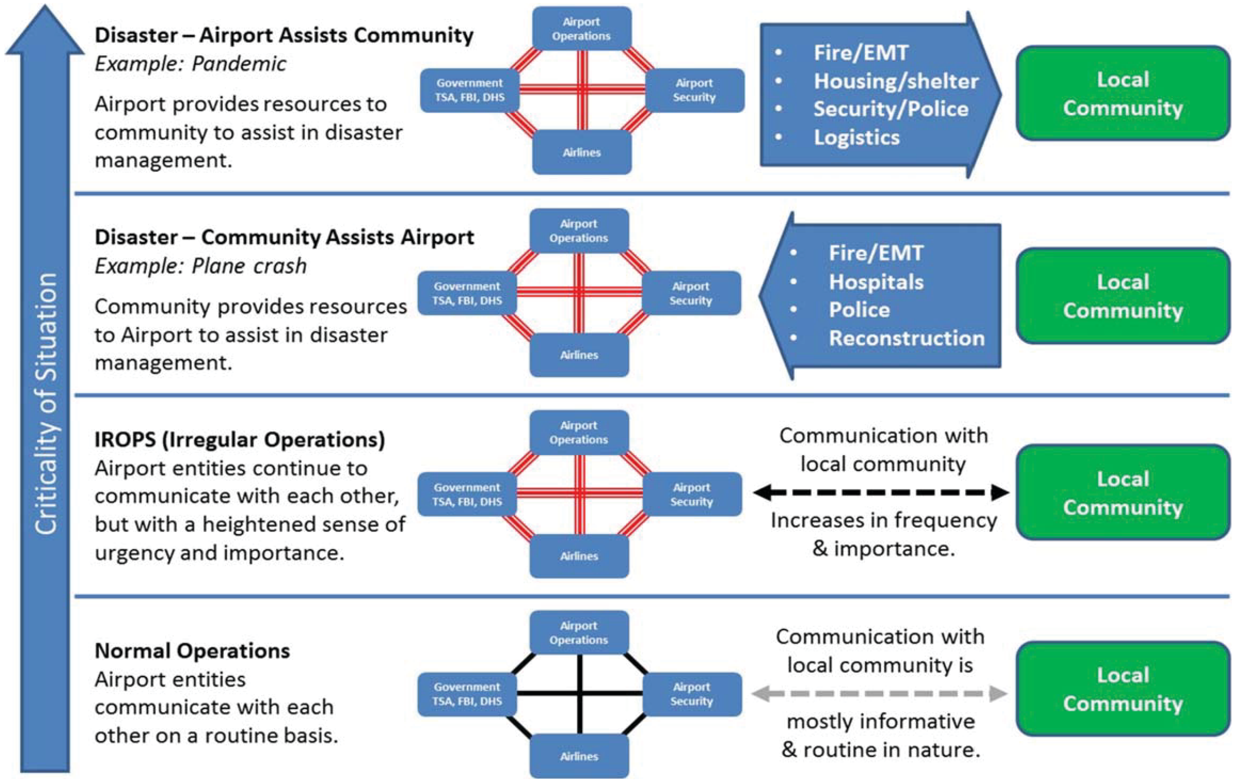

Figure 1-3. Airport communications/command and control center mission escalation.

1.5 Current Communications Center Models

ACCs may be challenging to design and build. Each airport is unique in terms of location, existing infrastructure, aircraft and passenger traffic, operational environment, and other issues; each airport operator has its own ideas of how to manage ACC-type functions and integrate them with airport IT assets; and each airport has different staffing and budgetary issues that define and limit the extent to which an ACC can be configured and supported.

No solution addresses all these issues, but there are many good examples which should be assessed when considering planning for a new ACC or expanding an existing ACC.

The most commonly found ACC models are as follows:

- **Airport Operations Center (AOC).** This facility is typically concerned with airfield movements, including ramp and gate management.

  An AOC is the focal point for daily airport operational functions and issues including, but not limited to, maintenance of the airfield, runway surface, lighting, and the management of terminal facilities and fueling facilities. An AOC can include control over gate operations and aircraft maintenance areas. In some facilities, an AOC may also encompass other landside operations such as traffic and parking operations. Generally, this will be a 24/7/365 operation although, in smaller facilities, the AOC may close for a period when operations at the facility stop or are infrequent. The AOC's design should support the CONOPS for airport operations, including linking the SOC and EOC in the event of an incident, because many security events will profoundly affect the continuing daily operations of the airport. The AOC manages routine work that is essentially the same every day, with occasional emergency response activities. Finally, AOCs may include monitoring building functions such as building automation and asset and maintenance management.

- **Emergency Operations Center (EOC).** Although primarily concerned with incidents that directly affect airport operations, EOCs may also address events such as large gatherings, natural disasters, or civil disorders, which occur beyond the airport but may involve both airport and non-airport organizations.

  The airport-related functions and communications of an EOC are found in the Airport Emergency Plan [FAA Advisory Circular 150-5200-31]. An EOC may be a temporary facility or may be in a permanently established facility. If the local community has established its own EOC, then the airport may maintain a Department Operations Center (DOC) which works with and under the community EOC.

  The airport EOC/DOC focuses on managing emergencies. Depending on the scale of the incident or event requiring activation, the airport EOC/DOC may be linked to local, state, or regional EOCs, to obtain or provide support. An EOC is often not occupied until it is "activated" when an incident occurs. In addition, EOC technology infrastructure is (1) often designed to accommodate internal and external personnel who may not be familiar with the systems that support the EOC and (2) scalable for a sudden influx of people when emergencies occur.
- **Security Operations Center (SOC).** This is the term used in the Transportation Security Administration's (TSA's) *Recommended Security Guidelines for Airport Planning, Design, and Construction* and in the Radio Technical Commission for Aeronautics (RTCA) *Standards for Airport Security Access Control Systems*. A SOC is often the key element in an ACC because of its specialty equipment and communication capabilities in addition to its responsibilities for maintaining a safe environment, which includes responding to security and emergency incidents.

  A SOC is the focal point for airport security monitoring, command and control, and communications functions. Generally, a SOC will be a 24/7/365 operation, staffed and designed pursuant to the guidance of the Airport Security Program (ASP). These functions often involve sensitive security information (SSI) or other law enforcement restricted material such as "Official Use Only," or "Be on the Lookout" (BOLO) alerts for which dissemination requires special controls. The SOC functions may include
  - Collecting information from many sources to provide situational awareness for command personnel. Enhancing situational awareness is a major objective. A SOC can be designed to leverage multiple communication links throughout the airport, including police, fire/rescue, airport operations, off-airport emergency assistance, and secure communication channels to federal, state, and local agencies, and may be used to coordinate the action of such agencies and airport personnel.
  - Coordinating security functions with other command and control functions, including physical or virtual links with other operations [e.g., AOC, EOC and Incident Command Post(s) (ICP)]. Careful consideration of who has authority to shift views or otherwise control CCTV operations should be developed by key personnel. There is considerable difference between observation, influencing change, taking over control, and command responsibility for committing resources.
  - Serving as a Police Dispatch Center, which may be integral to the SOC. In these centers, operators dispatch a range of public safety resources, including police, fire and emergency medical service (EMS) personnel. These may be resources controlled solely by the airport operator or may be resources provided by and, in some cases, shared with the surrounding community. Dispatch functions in larger operations often use CAD software. In dispatching, whether through the use of CAD or not, operators are often responsible for functions identified with a SOC.
  - A different version of a SOC may be maintained by the airport's IT department. This version focuses on the cybersecurity of the airport, its network, applications, data and any physical component that makes up the technology environment of the airport. A SOC is also terminology used in an IT environment for a cybersecurity center where networks and applications are monitored in much the same way as with physical security.
- **Public Safety Answering Point (PSAP)**, sometimes also called a Public Safety Access Point. A PSAP is typically a call center responsible for answering calls to an emergency telephone

number (usually 9-1-1) for police, firefighters, and ambulances, and is staffed by trained telephone operators who are responsible for dispatching these emergency services. The establishment of a PSAP carries with it a separate set of regulatory requirements that apply nationwide to emergency 9-1-1 call-taking operations. A registered PSAP operation is subject to standards for answering calls and dispatch operations. There are also funding streams open to PSAPs that are unavailable to non-PSAP call-taking operations.

A PSAP may also provide 9-1-1 service to areas outside the airport perimeter. PSAPs are set up to receive and process emergency calls and event notifications for a specific area. A PSAP may dispatch public safety personnel such as police, fire, and EMS in response to calls for service and should be able to accommodate additional operators during emergency situations.

- **ICP.** An ICP may have several responsibilities and will likely not be a fixed location because it may be co-located with other responder facilities as an incident evolves or may be a mobile facility. The ICP is often at or near the scene of an event or incident. An ICP may be integrated into the Police Dispatch Center or associated with an EOC. Some of an ICP's response functions may also be performed by an AOC. The ICP is generally operated in connection with the National Incident Management Systems (NIMS).
- **Fusion Center.** This facility is designed to integrate multiple organizations in a single facility to encourage cross-agency collaboration. Fusion centers are typically used by government agencies to collaborate on intelligence issues that are not easily communicated via more formal channels of communication. Multiple agencies can collaborate to provide resources, expertise, and information to the Center with the goal of maximizing the ability to detect, prevent, investigate, analyze, and respond to criminal and emergency activity. The airport is often a participant/user rather than the host agency.
- **Hybrid ACCs.** The hybrid model is the most common. It includes various functions and processes from some or all of the above models. As an airport develops its CONOPS, it will choose from among these models and develop its own approach. (A more descriptive outline of a hybrid ACC is included in Section 1.6 below.)

1.6 Virtual, Single-Function, and Multi-Function Centers

Examination of the user requirements for airports of varying size and complexity presents a range of options for the design and configuration of communications centers. Although "ACCs" may suggest images of a single physical location supporting a multi-function operation with multiple workstations, video display walls, and complex technology solutions, this may not be the best approach for every airport, especially small airports. Each airport management team must choose a direction that works for its own specific environment.

There are six key factors in determining the appropriate configuration of the communications center:

- The CONOPS, as developed specifically for that airport's operational environment
- Local conditions and operational preferences defined by stakeholder user requirements
- Legacy and planned technology systems and applications
- Existing organizational structure
- Available funding
- Input from the non-airport communities

When seeking an appropriate model for an ACC for any given airport, the optimal solution depends on the individual physical and operational characteristics of the existing legacy systems and the desired operational state as determined by user requirements of the stakeholders in developing the Concept of Operations. There is no single one-size-fits-all solution; in fact, several equally valid solutions with somewhat different configurations, different priorities, or different degrees of integration may exist.

1.6.1 Virtual ACC Configuration

A virtual configuration is a multi-function ACC not housed physically in one location. This may be necessary for various reasons, most typically because no single structure is available that possesses all of the physical attributes needed. However, there could also be geographic dispersion concerns where multiple airport sites are spread over a large geographic area and it is not possible to choose one single site. In this case, the ACC is physically dispersed in various locations, each in a separate structure, connected virtually through advanced communications.

Virtual communication—which allows sharing of audio, video, and other content in real-time online—is a growing presence in the airport environment made possible by traditional technology tools, such as video and audio conferencing, and an airport's desktop infrastructure (email, phone). Virtual communication is encouraged because of the growing reliance on mobile devices such as Geographic Information System (GIS)-enabled smartphones and tablets, using safety management system (SMS) messaging, Skype, and other advanced communication features.

With the proper communication environment in place, an airport operator can maintain constant communication with various geographic locations and staff resources without being physically co-located.

1.6.2 Single-Function ACC

A single-function ACC focuses on a single operation, generally limited to basic communications channels and technology. For example, airfield operations could be the sole function. A single-function ACC is (1) typically found at smaller airports, (2) dedicated to a specific set of communication requirements, and (3) generally operates as a separate physical and operational facility.

A single-function ACC will typically include the following:

- Telephone services (switched or Voice over Internet Protocol)
- Public information and courtesy calls
- Paging
- Radio dispatch
- Voice and/or data services for coordinating on-airport operating staff

In most scenarios, this will be a relatively small facility, requiring limited technology beyond basic communications and monitoring capability and staff and providing limited situational awareness.

For a smaller, less complex airport, a single function ACC may be the most cost-effective and event-responsive solution. This approach is less costly in terms of staffing, technology, and space, and requires less training in terms of number of systems, policies, technical understanding, and proficiency.

The downside of single function ACCs, especially as operations become more complex, is the risk of compartmentalizing the operations and information. This can be addressed with strong organizational and operational practices, but there is always the risk of a lack of situational awareness or delays in communication or collaboration. Another disadvantage is the consequences of decisions made in a "stovepipe" environment, i.e., without a full range of necessary information, communication, and coordination.

1.6.3 Partial Multi-Function Configuration ACC

Partial integration of an ACC introduces a range of possible scenarios and will typically include a combination of operational and technical integration. In this model, more than one airport organization, but not all, will be physically co-located for better collaboration, information sharing, and decision-making. For example, operational activities such as facility and building management and airside and landside operations may happen in a single location.

In the partial configuration, typically the level of communication increases as different technology solutions are brought into a common center. This situation often results in an operations console configuration with multiple workstations providing visibility and management of a range of different systems.

A partial configuration can be beneficial at several levels. It can be applied to existing spaces and staffing operations that have limited capacity to expand or incorporate new systems and personnel. It can also be used to migrate a purely communications-focused facility and operation to a broader range of responsibilities, without full integration.

For example, an ACC with monitoring capability and managing all security and life safety alarms requires a relatively simple level of technical integration, while providing a great deal more information to the ACC staff and end users. Similarly, adding dispatch for security, fire, and life safety personnel can be accomplished by either adding a CAD system or providing read-access to the CAD—this requires only a modest level of technical integration and additional training, without putting significantly greater demands on space or personnel.

A partial configuration can serve as an interim step toward full integration, allowing the airport operator to move in a set of reasonable, well-planned steps over time toward a more complex operation if and when wanted. This approach allows for a measured process, with funding, training, integration, and other steps being accomplished along a multi-year plan, and diminishes the potential disruption of the facility, the airport, and operations. This approach also minimizes human factors that often create resistance to changing environments and may serve as a proof of concept to validate each element planned, one step at a time.

One of the challenges with this approach is to have a sufficiently clear long-term plan to allow the initial configuration to support and integrate with future developments in terms of technology, space, operations, funding, and people.

The disadvantages inherent in a partial configuration are the continued need to coordinate and collaborate with other non-integrated facilities (e.g., law enforcement, media relations, or concession management) and resource inefficiencies inherent in the redundant staffing requirements.

1.6.4 Full Multi-Function Configuration ACC

Full integration of the ACC is generally an aggregation within a single location and normally adds a second backup location with full operational capability. In essence, the ACC becomes an overall centralized command and control center. Typically, this means the facility will handle the following:

- Communications center functions
- Security monitoring and dispatch
- Life safety, i.e., police, fire and medical
- Facility and building management systems, maintenance
- Airside operations
- Landside and terminal operations
- Parking management
- Paging, lost-and-found
- Gate management
- Mutual-aid coordination
- Irregular operations

This often requires the following:

- A scalable, flexible, protected physical environment to meet current and future needs.
- Integration of personnel with broader capabilities and responsibilities, and appropriate cross-training.
- Introduction of more complex and robust technology systems to manage multiple origins of information and data gathering into a more intelligent output that may include analysis, work flow, trending, reports, and dashboards.
- Integration or convergence of systems and information sources.
- Addition and/or modification of operational policies and procedures.

Most challenges usually associated with full integration are manageable, but must be planned for in the CONOPS. These challenges may include the following:

- Higher original costs of more complex technology systems and integration
- Increased maintenance costs and complexity
- Higher levels of personnel requirements and increased training requirements
- Increased space and infrastructure requirements
- More extensive record-keeping and distribution requirements

Full integration has several benefits, including the greatest degree of situational awareness and promotion of the highest level of staff communication and support, through co-location and cross-training of personnel. With an increasing IT capability to integrate diverse data and information sources into single-platform workstations, the full integration approach allows access to more information. Additionally, the aggregation of the data and synthesis of more complete information affords more effective and informed support for determining trends for future decision-making and response.

Most multi-function communications centers in airports are seen as a positive change, by deploying more efficient responses, diminishing operational down times during irregular operations, and supporting better management of time and materials for improved budgeting responsiveness. Multi-function communications centers are not just for large hub airports-smaller airports with fewer staff can benefit from cross-training and, therefore, cross utilization of reduced staff. A smaller airport may consider a phased approach, using partial integration to help with technology transitions and funding by spreading it out over a period of time.

The decision to have a standalone, partially integrated, or fully integrated ACC is rarely a matter of answering the single question of which is the best solution. The solution is best defined by developing a detailed CONOPS to determine the operational needs placed on the ACC by the airport and a full complement of users.

Investment of the necessary time and resources to do a comprehensive CONOPS plan for a future ACC is essential, irrespective of the model or approach being considered. Incorrect decisions are considerably less expensive to correct during the initial planning stages than during construction or, worse, in the face of an emergency situation.

1.7 Examples of Current Communications Centers

1.7.1 O'Hare Incident Management Center (IMC)

The O'Hare IMC serves as a coordination center for multiple departments during emergencies. Located on the airfield, the IMC was designed to be reconfigurable as circumstances required. It is not a 24/7/365 operation but is activated to respond to large-scale events and incidents. It can function both as auxiliary space to augment the main Operations Control Center (OCC) and as a backup center for some functions of the OCC.

The IMC is scalable to accommodate additional users as new participants arrive from state, local, and federal organizations that need access to communications, information, and working space. The O'Hare IMC is quickly reconfigurable, using a "no-console" modular furniture design concept. All systems are computer-accessible with proper authorization. The IMC can accommodate up to nine operators, depending on event requirements. The 100% Server/Network-based digital systems are all accessible from a single user interface and include the following:

- Digital video management system
- Access control system
- CAD system
- Video wall and display management system

1.7.2 Los Angeles International Airport (LAX)—Airport Response and Coordination Center (ARCC)

The ARCC is an integrated communications center that coordinates a range of activities. It operates 24/7/365. The Center's physical layout accommodates airside and landside operations, police, and construction/maintenance services divisions, and several governmental agencies. The information technology and management group also maintains a presence in the ARCC to provide support and manage IT issues should they occur. A separate section is activated in response to a major incident, with assigned workstations for managers of response teams, and providing shared access to information from initial response through full recovery, thus reducing response time to activity that may affect the traveling public.

The ARCC functions include the following:

- Physical security information management (PSIM) system
- Video wall and large displays/liquid crystal displays (LCDs)
- Work order management system
- Crisis management system
- Emergency notification system
- Digital trunked radio system
- Airport Part 139 compliance software
- Voice recording system
- Weather and traffic alert system
- Physical access control system (PACS)
- Video management and review for closed-circuit television
- Fire and life safety systems
- Gate/bus management
- Traffic management

1.7.3 Metropolitan Washington Airports Authority (MWAA)

MWAA operates a single integrated ACC for two airports, the Ronald Reagan Washington National Airport (DCA) and Washington Dulles International Airport (IAD). The ACC is in Hangar 5 at DCA and combines a Police Dispatch Center with an SOC and an EOC.

The ACC uses CAD technology which allows staff to (1) dispatch fire, police, and maintenance personnel to multiple facilities and (2) monitor and respond to access control and CCTV systems at multiple facilities. During an emergency, camera control/operation may be overridden by selected facility operations personnel.

1.7.4 Midway International Airport (MDW)

MDW operates an ACC structure similar to Chicago O'Hare (ORD). The MDW Communications Center (MCC) provides communication services for public safety assets. A separate Ops Center manages Federal Aviation Regulations (FAR) Part 139 compliance. The major differences between ORD and MDW are the smaller scale at MDW and the type of dispatch functions based on the Concept of Operations specific to MDW public safety personnel. For example, ORD dispatches fire personnel from three dedicated fire stations. At MDW, the fire station is shared with the surrounding urban neighborhood, so dispatch is conducted by the City's 911 dispatch center.

The MCC is in the terminal area, where square footage is at a premium, thus limiting the ability to use it as a Crisis Management Center (CMC). Similar to ORD, the CMC functions at MDW are not collocated; they operate from a more remote area of the airport, in the sterile area, which limits access. The MDW radio system uses a 6-channel 470-MHz trunked radio system for dispatch and communications and has no redundant repeater site.

1.7.5 Sarasota-Bradenton International Airport (SRQ)

This small airport operates an integrated ACC in the form of a SOC and AOC, combined with an adjacent EOC. AOC communications, security monitoring, and operations occupy the same suite of offices, but do not use the same stations. Called AIRCOM 1 and AIRCOM 2, they are not configured for routine operations functions, but can support operations during airfield incidents and emergencies. The SRQ AOC is not provisioned for operators to reside in the AOC overnight during emergencies.

The ACC staff's responsibilities consist of monitoring essential safety and security systems, including the access control and fire alarm systems, the Air Traffic Control Tower ring-down emergency line, and the CCTV surveillance cameras. AIRCOM also manages all airport emergency calls, answers public calls, and makes paging announcements. AIRCOM provides dispatching service via the 800-MHz radio system base unit to all airport groups, including Police, Fire, and Operations. In the event of a major incident, AIRCOM coordinates all mutual-aid calls to outside responding agencies.

The current AOC site was decided in post-9/11 planning sessions; its predecessor was in a cramped ground floor room, below the TSA checkpoint. Moving the AOC to another terminal area enabled a configuration to include offices for Operations and IT and communications equipment. The Airport Police Department (APD) inherited the older AOC space so that its officers could remain close to the TSA checkpoint and respond to incidents quickly.

Current communications modes and technologies include the following:

- Wired telephony, which is the primary means of communicating with external parties.
- Trunked radio talk groups, assigned on the Sarasota City 800-MHz radio system and used by the operations and maintenance staff. APD also operates a separate 800-MHz trunked radio provided by Manatee County, which is not interoperable with the City of Sarasota radio system.
- Cellular telephones used by the airport management and operations staff for routine activities and receiving alerts, including notifications of security breaches and emergency events. SRQ has two cellular carriers; each uses a different modulation scheme. The CDMA-based carrier primarily serves the airport management staff. The GSM-based carrier primarily serves operations and maintenance and its service includes a push-to-talk party-line type radio mode, commonly known as Direct Connect, which is popular with the maintenance personnel. Both cellular carriers have made arrangements for SRQ to have priority channel access during emergencies.
- Standard very-high frequency (VHF) radios for airfield and air traffic control (ATC) tower communications.

1.7.6 Tampa International Airport (TPA)

Hillsborough County Airport Authority (HCAA) is an independent operating unit within Hillsborough County. HCAA operations, engineering, and IT departments determine their own operational and technical requirements and select the best solutions to meet these needs.

The APD at this medium-sized airport operates a Police Dispatch Center, linked through the County Sheriff's Department with other County departments for support during emergencies.

TPA has configured an Integrated Communications Center, known as the Airport Operations Center (AOC), which provides police dispatch, security monitoring, and emergency operations support functions, including response to incidents and natural disasters; it is staffed 24/7 by police and operations personnel who operate a full set of communications modalities, including wired and cellular telephony, 800-MHz trunked radio talk groups provided by Hillsborough County, and a local area network (LAN) capable of carrying Internet Protocol (IP) telephony.

1.8 Examples of Non-Airport ACC Facilities

1.8.1 City of Chicago Response Centers

The Chicago Office of Emergency Management & Communications (OEMC) operates the City's public safety communications systems that coordinate the response of police, fire, and EMS resources to 911 calls. The OEMC is a 161,000-square-foot facility on the west side of Chicago that relies on a secure communications network with hundreds of miles of buried fiber-optic and copper cable dedicated to providing City 911 and 311 services. OEMC uses several key technological and infrastructure elements.

Chicago's Joint Operations Center (JOC) is designed for use during major emergencies, providing complete communications capabilities for all police, fire, medical, city, state, and federal command personnel. Each workstation is equipped with a telephone and online capabilities, allowing staff to connect directly to their offices and networks. Three large-screen televisions enable the JOC to monitor local, national, and international events. The JOC has video technology to link the OEMC with City Hall and the Chicago Police Department Headquarters, with live video conferencing capability.

If an incident occurs, the OEMC can pinpoint the location, designate a specific radius around the location, and call all land-line phones in this predetermined area with a message capability of up to 1,000 phones per minute, chosen from a library of options, or a custom message for a specific incident.

The OEMC operates a mobile communications vehicle capable of coordinating disparate radio bands for multiple first-responder resources. The vehicle is designed to support City first responders, and county, state, and federal agencies operating within 75 miles of the City.

1.8.2 Fairfax County, Virginia, Public Safety Transportation Operations Center (PSTOC)

The Fairfax County PSTOC, a large regional fusion center, links the Fairfax Department of Public Safety, Police, Fire, EOC, Water and Wastewater departments; the State Department of Transportation (VDOT), Office of Emergency Management, and State Police; and EOC facilities in nearby counties. It also serves as a Regional Incident Coordination Center, with potential for coordination service to both DCA and IAD. The facility has a 100-ft setback and other blast-resistant measures.

The PSTOC co-locates the following functions:

- VSP (call-taking, dispatch and support)
- VDOT (Smart Traffic Center, signal system and support)
- County 911 call-taking and support
- Fire Department dispatch
- Police Department dispatch

SECTION 2

Components of an ACC

An ACC may take on a seemingly endless variety of configurations. It will likely evolve and become larger and more complex as the airport operator gains experience with its operation and realizes the increasing benefits of a coordinated focal point for communications. This section provides guidance on components of a potential ACC that may be overlooked when first outlining ACC functions, goals, and objectives. Some components are physical, others are functional, and still others are organizational. Nevertheless, all these components should be considered in the decision and included in the CONOPS, as appropriate.

2.1 ACC Policies

A robust, comprehensive, documented set of policies is essential for every ACC, no matter the size. In almost all cases, an airport will have an established set of policies in place. Policies created for the ACC could be a subset of the existing airport policies or could stand alone. However, the airport operator needs to ensure that newly created ACC policies are consistent with existing airport operational policies.

The number of policies that need to be developed for a new ACC will vary, depending on the airport and the intended mission and goals of the ACC. There is no one-size-fits-all approach to policy development, because each airport will likely have a different foundation on which to build its ACC policies. However, any new ACC will likely require policies that outline the following:

- Hours of operation
- Staffing and coverage
- Interaction among ACC organizational components
- Internal meetings and communication channels
- Documentation of irregular operations
- Procedures for communicating with external entities

One of the most important potential benefits of an ACC is that an airport will produce the same (or similar) desired outcome each time it encounters a particular condition or stimulus. To achieve this goal, policies must be established that clearly identify a system of principles to guide decisions and achieve rational outcomes.

A policy is, therefore, a statement of intent and is implemented as a procedure or protocol. Policies may be developed by various entities within the airport, such as the board or senior governance body, the airport director, external political entities, other airport organizations, or even the ACC. Policies can assist in both *subjective* and *objective* decision-making. Policies to assist in subjective decision-making would usually assist senior management with decisions that must consider the relative merits of factors before making decisions and which are, as a result, often hard to test objectively (e.g., a major aircraft incident or an active shooter). In contrast, policies to assist in objective decision-making are usually operational in nature and can be objectively tested (e.g., responding to a door alarm).

Policy differs from rules or law. Although law can compel or prohibit behaviors (e.g., FAA requirements), policy merely guides actions toward those most likely to achieve a desired outcome.

Furthermore, policies are supplemented by procedures or protocols typically designed by the ACC to implement the established policies in a common, process-oriented manner.

Using a consistent approach when creating a new policy is critical to policy development. As an example, the following eight-step policy cycle is found in *The Australian Policy Handbook* by Peter Bridgman and Glyn Davis:

- Issue identification
- Policy analysis
- Consultation (which permeates the entire process)
- Policy instrument development
- Building coordination and coalitions
- Program design: decision making
- Policy implementation
- Policy evaluation

Perhaps the most overlooked and underrated step in the policy lifecycle is policy implementation. A critical element in ACC management is ensuring that all policies are clearly documented, understood, and followed and that employees understand the ramifications of not following policy.

2.1.1 Policy Format and Taxonomy

All policies must follow a standard format to ensure consistency between policies. A sample description of the information that should be included for each policy follows:

- **Policy Number.** For new policy drafts, this section should remain blank until a number is assigned by the Policy Group. For revisions, this number will remain unchanged.
- **Effective and Revised Dates.** To be determined by the Policy Group.
- **Policy Title.** Should capture the content of the policy but should **not** include the word "policy."
- **Policy Metadata.** Key words that describe the policy.
- **Purpose.** A brief statement of the purpose of the policy; this may include a basic explanation for the policy if not apparent on its face.
- **Policy Body.** The policy should be stated in detail and in unambiguous language such that there can be no confusion as to what the policy requires and the expected outcome from following the policy.
- **Additional Authority.** A list of statutes, regulations, board policies, Airport Director Orders, or other relevant authority governing the policy.
- **Scope.** Addresses to who or what the policy applies.
- **Responsible Party.** A list of the unit, department, or other pertinent area responsible for administering or enforcing policy.
- **Definitions.** Uncommon words or words with meanings unique to the airport industry should be defined for new staff members.

Where the policy requires that **procedures and processes** be developed to ensure that the policy is consistently followed, **the full procedure,** including all the steps necessary to comply with the policy with sufficient detail that end users will readily understand how to comply with the policy, should be included. Similar to the policy, the procedure template should be standard and consistently published so that the reader can quickly understand the process that must be followed. When developing procedures, a step-by-step approach is usually best.

2.1.2 Policy Taxonomy

Developing a system of classifying, numbering, and organizing an airport's policies requires developing a policy taxonomy. Most airports using this Guidebook probably have already developed a policy taxonomy and the ACC should use the existing protocol to maintain consistency with the rest of the organization.

If no taxonomy exists, the airport operator should consider developing a simple taxonomy representing major lines of business (e.g., landside, airfield, and public safety), each with its own distinct number and relevant subcategories. A taxonomy should be scalable so that policies can be added over time without fully using the numbering system.

Finally, a system of metadata should be established so that policy users can quickly locate policy information, especially in times of emergency. Metadata consists of key words that describe the airport policy (e.g., runway, airfield, and airfield lighting). In other words, metadata acts as a catalog to help users locate policies quickly, especially if the airport makes the policies available on line on its airport intranet.

2.2 Call Center Functions

An airport call center is usually a physical place where an organization handles telephone calls from passengers, tenants, airlines, and other entities, usually with some computer automation. Typically, a call center can handle a considerable volume of calls simultaneously, screen calls and forward calls to individuals qualified to handle such calls, and, finally, log calls. Two related terms are virtual call center and contact center.

In an airport, the three most common call centers are (1) public and passenger information; (2) reporting of facility issues by tenants, concessionaires and passengers; and (3) public safety. If the airport operator wants to relocate an existing call center or create a new one for its planned ACC, additional planning will be necessary and, for new call centers, this planning will likely involve the addition of new call center technology.

Sophisticated call center technology is available to operate a call center. The challenge is to select the right technology, implement it properly, and then optimize daily performance. The correct technology reflects the call center's purpose, size, and location, and how requests are received (e.g., phone calls, emails, faxes, and grey mail).

Technology options to consider include

- **Automatic call distributors and/or dialers.** All call centers need a system to process calls and other interaction types like email and chat. Automatic call distributors (ACDs) and/or dialers are core call center systems; all other applications are intended to complement and improve the performance of these two underlying systems. Inbound call centers use an ACD to manage the flow of incoming calls and route them to the most appropriate agent. Outbound call centers need a dialer to place and complete calls.
- A **crew resource management (CRM) application/call center servicing application.** A CRM application provides a database of the tenants, concessionaires, airlines, and other parties likely to contact the airport's call center. Call takers use the servicing application to respond to customers with an understanding of their contact information and relationship to the airport.

Call takers can also use the servicing application to document customer issues or requests and steps taken to address those issues. This creates a record of interactions that can be accessed the next time the customer asks for help.

- **Call recording systems.** Most customer service environments—inbound or outbound—require recording systems to capture all interactions so that they can be replayed if there is a question about an interaction. Some systems just capture calls; others capture both the call and related screens used to serve the customer.
- **Interactive voice response systems/speech recognition systems (IVR).** IVR systems are self-service tools that automate the handling of incoming customer calls. Advanced interactive voice response systems use speech-recognition technology to enable customers to interact with the IVR by speaking, instead of pushing buttons on their phones. IVR/speech recognition systems can help airports reduce the number of staff necessary to take calls by automating the handling of 40% to 85% of all incoming calls. Using an IVR may mean that airport stakeholders are disappointed they are not getting a "live" person to answer their question.
- **Quality management applications.** Quality management applications are used to measure how well call center agents adhere to internal policies and procedures. These applications are increasingly considered mission-critical for inbound call centers, because they give management insight into call center performance. This application would only be necessary in an airport with a high volume of calls.
- **Computer telephony integration (CTI).** CTI connects the ACD to any of the other applications or to the airport's internal work order system. At the most basic level, it delivers a "screen pop," bringing up the customer's account on the agent desktop when it delivers a call. This saves the call taker from wasting time looking up customer information and it saves the customer the aggravation of having to provide redundant identification or account numbers. CTI is a major productivity tool for many call centers.

Most airports will use their IP network for transporting call center communications. Developing a new call center will require a review of the existing network to ensure that it has the stability, scalability, redundancy, and flexibility to handle this new function.

2.3 Technology

Technology is discussed in depth in Section 7 of this Guidebook. When either extending legacy applications to a new ACC or acquiring new applications, the airport operator should use the traditional method of developing a functional requirements document (FRD) to ensure that the technology selected meets the needs of the users and stakeholders and the objective of the ACC.

A typical FRD will contain the following information:

- An outline of the business objectives and business processes
- A complete set of requirements which will be matched to various applications
- A description of the capabilities the application(s) must provide in business terms
- Criteria by which the success of the software and hardware can be measured

In addition, for an ACC, the CONOPS is a critical document for specifying the functionality that will be considered in an FRD. Both documents should be consistent in their basic information, but the FRD focuses on a specific technology application, whereas the CONOPS looks at a specific business process.

Once the FRD is complete, the airport operator will use its normal procedure for acquiring and implementing the software. Although an integrator is often a desirable external resource, because of the complexity of meshing so many non-integrated systems, it is not always necessary.

When considering technology, airport management should ensure a thorough search for the technology that best suits the airport's needs and be wary of marketing material claiming to provide everything necessary for the ACC in one suite. Often, these systems require the airport to have a substantial number of underlying "feeder" systems for the technology to reach its promised potential.

2.4 Human Resources

Perhaps the most potentially difficult aspect of developing a new ACC is ensuring that the personnel who will be in the ACC are fully aware of the mission, goals, and objectives of the ACC. First, the ACC's mission, goals, and objectives need to be developed, approved by airport management, and clearly stated in a documented format available to all personnel. In-person meetings where management and ACC personnel can discuss the direction that management is planning to take the ACC are helpful. Enabling employees to ask questions and clarify direction is essential to creation of a cohesive operating ACC. This is particularly important where the ACC is bringing together airport operational units not previously co-located. The most challenging aspect of ACC development is ensuring that all of the parties take advantage of the new technology through collaboration, interaction, and enhanced communication.

A second critical component regarding human resources, especially when developing a new ACC, is ensuring that all personnel get extensive training on all new software and hardware prior to the opening of the ACC. This is often overlooked, frequently because the personnel may indicate they are too busy with daily activities to undergo training. However, without training, the ACC, at best, is likely to take an extended period to reach its intended goals and, at worst, could fail. This is especially true where new technology is being implemented that had not previously existed in the airport. As part of the training, the airport operator must emphasize that the newly purchased technology is mandatory and that personnel must use it.

Creating a new organizational structure is a third critical component which may be necessary, depending on the number and type of functions included in the ACC. In some cases, the ACC becomes a new integrated organizational structure within the airport environment and existing reporting relationships must take into account this new entity. Daily activities may need to be managed by an ACC manager or director who does not normally have supervisory or management authority over all of the personnel housed in the ACC. Establishing means for command and control outside the normal organization is important to ensure that daily activities are planned, communicated, conducted, and reported. It must be clear who is authorized to direct operations and provide guidance.

Breaking down "organizational silos" is the fourth and, often, the most vexing of the human factors to address. Traditional airport organizations already have formal and informal communication channels in place. Existing working relationships, friendships between personnel, social interactions, and even internal rivalries—all will complicate formation of new collaborative relationships in an ACC. Airport management must be sensitive to how best to meld these long-standing silos into a single entity in its new ACC. Unfortunately, no single approach ensures success. However, promoting continuous and meaningful communication, sharing of organizational successes among all groups, frequent interpersonal interactions and joint ownership in initiatives will go a long way in creating that unified environment airport management desires. (See Section 2.9 for more discussion on this topic.)

Finally, new ACC technology may require job redefinition of some ACC personnel. Technology is least effective when it is only used to automate existing procedures. At least some degree of organizational change is needed, in the form of "business process-reengineering." Every new technology added to the ACC should be considered in light of the potential changes that could be made in terms of the existing procedures and processes and for the staff involved. One final issue is the there is the danger for "information overload," and, in serious cases, "employee burnout" may be induced by the new environment, because of the possibility of bombarding employees with ever more data.

2.5 External Agencies

When considering developing an ACC, the airport operator needs to consider three areas of potential communication channels. The first (and most obvious) is the internal airport organization. The second is other airport stakeholders (e.g., airlines, tenants, concessionaires, vendors, ground transportation organizations, ground services, and catering). The third group consists of entities external to the airport, including the immediate community (where applicable); the airport board; and federal, state, and local agencies (particularly those that have direct oversight or input into airport operations). Determine to what extent each of them will have either a direct connection to the ACC or participate in some ancillary manner.

For the airport's internal organization, the answer may seem obvious and relate solely to those entities with a specific role in the ACC. However, there may be some consideration necessary of other airport organizations which, although not directly involved in daily operations, may have an active interest in ACC activities, share in the generated data, and even be called to the ACC during special circumstances. A good example of this is media relations—staff from which may be called on to present airport operational activities to the media and public.

Other airport stakeholders must be given consideration to ensure that can easily provide input and receive generated information, on a need-to-know basis. In some airports, especially where one airline is the overwhelmingly predominant carrier, that carrier may have personnel who work in the ACC as the airport-airline interface. Although it is unlikely that any other intra-airport entity will be large enough to merit consideration for a physical presence in the ACC, all stakeholders must have the same understanding of the mission, goals, and objectives of the ACC and how it will interact with each stakeholder during normal, heightened, and emergency periods.

Finally, careful consideration needs to be given to all potential external entities that may have an interest in the airport, particularly when there is an emergency or special activity of some kind. Planning for extending communication channels to these entities is important from the onset of ACC planning. Such channels may be as simple as an audiovideo conferencing arrangement with the local government or EOC or as detailed as including these parties in an emergency communication application.

Once airport management determines the level of participation of all non-airport groups, a memorandum of agreement (MOA) should be created between the airport operator and the external entity to determine what the relationship will be with the ACC. Simple things such as the use of outside technology (e.g., flash drives and laptops) must be regulated to prevent malware from non-airport equipment being accidently imported into the ACC, especially in times of emergency. An MOA should also include information on when the external parties are expected to be present in the ACC, and, just as important, when external parties are not permitted.

Each airport operator will have its own unique set of rules between itself and its external stakeholders and these requirements need to be considered, documented, and agreed on before a situation arises where they might be needed.

2.6 ACC as a Component in the National Incident Management System (NIMS)

Depending on the size and scope of an airport's ACC, it may have numerous elements that are also important components in the NIMS Incident Command System (ICS). In fact, the FEMA definition for ICS as a "standardized approach to the command, control, and coordination of emergency response providing a common hierarchy within which responders from multiple agencies can be effective" is remarkably similar to a large-scale ACC's mission statement. As such, an airport operator should consider if or when the ACC may be made available during emergencies or "events," as defined by ICS.

Perhaps the most compelling connection between an ACC and ICS is the technology included in the ACC. In both cases, converged communications are essential for the successful execution of the operation. ICS requires that an integrated voice and data communications system, including equipment, systems, and protocols, be established prior to an incident; this is exactly what is implemented when establishing an ACC. Using an already-established technology platform for both the ACC and for ICS may produce benefits for the airport operator in terms of consistency, cost, uniformity, and readiness for use in the event of an incident.

Other reasons to consider the relationship between an airport ACC and the ICS are as follows:

- Both the ACC and ICS establish new organizational hierarchies to control personnel, facilities, equipment, and communications (although in the case of ICS it is temporary for the duration of an incident). These hierarchies are superimposed on the normal organizational structure.
- Both the ACC and ICS are interdisciplinary (depending on the functions within the ACC) and organizationally flexible to collect data, develop information and situational awareness, meld personnel from different organizations, use a common terminology, reduce duplication of effort, and provide a mechanism for collaboration, communication and cooperation.
- Although an airport ACC's main focus is daily operations, both the ACC and ICS deal with incidents (defined as unplanned situations necessitating a response) and events (defined as planned situations). Incident command is increasingly applied to events both in emergency management and non-emergency management settings and it is not uncommon for an airport ACC to be a focal point for communications for planned events.
- One of the benefits of both an ACC and ICS is that both entities are based on the principles of coordinating a set of organizations that may otherwise work together only occasionally.
- The ACC operates based on a CONOPS and established policies and procedures, according to a mission statement, goals, and objectives. Similarly, the ICS creates an Incident Action Plan to ensure that everyone is working in concert toward the same goals set for that operational period by providing direction for the actions to be taken during the duration of its operational lifecycle. In both cases, the goal is to reduce freelancing and ensure a coordinated approach to operations and communications.
- The ACC could act as an Incident Command Post (ICP) if the ACC is in the geographic location of the incident or as an ICP for planned airport events.
- Although not an official part of the ICS, an EOC is a permanently established facility and operation for a political jurisdiction or agency. EOCs often, but not always, follow the general ICS principles. For many jurisdictions, the EOC is where elected officials will be during an emergency but does not provide command during an incident or event. An EOC is responsible for the strategic overview, or "big picture," of the disaster and does not normally directly control field assets, instead making operational decisions and leaving tactical decisions to lower commands. Critical to an EOC is its communications system. In most cases, such a system is a sophisticated encrypted communications networks with a redundant path to ensure that both situational awareness information and strategic orders can pass through the facility without

interruption. Given the important similarities between an ACC and an EOC, an airport operator should consider the potential of a relationship.

2.7 Joint Information Center (JIC)

A JIC is an official part of the ICS and is the facility where an incident, agency, or jurisdiction can support media representatives. Frequently co-located in an EOC, the JIC provides the location for an interface between the media and the public information officer. The JIC often provides the space and technical assets (e.g., Internet, telephone, and power) necessary for the media to perform their duties. A JIC also often becomes the "face" of an incident because the JIC is where press releases are made available and where many broadcast media outlets interview incident staff. A permanently established JIC can be co-located with an EOC or, in this case, an airport ACC.

If an airport operator decides to include its ACC as part of the ICS or even just for planned events, the operator may want to include a JIC to handle media inquiries and act as the primary outgoing communication channel for the airport. A JIC will likely include additional hardware and software dedicated for media outreach purposes. Some displays, desktop PCs, telephones, and printers may be needed to support the media relations personnel. A more advanced JIC could include a soundproof room where audio/video recordings and/or interviews can be conducted. For interviews, special lighting and a background would also be required. If a JIC is being considered for an ACC, the project team should work closely with the media relations staff to determine their needs.

2.8 Eliminating Organizational Silos

One of the most challenging aspects of creating a multi-function ACC is melding numerous airport organizations into a cohesive, cooperative, and communicative entity. The ACC may have its own organizational structure that blends different airport divisions into a combined unit just for the operation of the ACC.

Airport management should not assume that co-location is all that will be necessary to ensure the various airport operational components act as a team. An airport operator can take the following steps to ensure that the ACC functions as intended and that desired collaboration and communication are achieved:

- Develop a common, objective understanding of the purpose of the ACC and how it is to operate. Much of this information is included in the CONOPS, but it is important to communicate with all ACC personnel to ensure they all understand the CONOPS in the same way. A critical element of this is emphasizing the interests of the enterprise over the individual.
- Establish a clear manager for the ACC. Whether it is the duty manager or someone else, decisions need to be made and someone must be authorized to take charge in case of disputes or incidents.
- Clearly defined roles are important. Although roles and responsibilities may seem obvious, airport management needs to realize that the ACC is creating new functions in terms of facility management, systems, data collection, and information production. Someone needs to determine who will do these tasks.
- Airport management must emphasize that success is defined collectively, not individually. Although individual recognition is important for morale, every opportunity to celebrate the accomplishments of the ACC as a whole should be taken.

- In smaller airports, which may have less flexibility in this area, choosing the right people to work in the ACC environment is important. Not every staff member works well in a team and just one person working out of sync can reduce the effectiveness of the ACC.
- In airports with a strong union presence, airport management would be wise to include formal union representation from the onset to ensure that organized labor sees that their members' rights and needs are being considered. Even where this may not be required by a collective bargaining agreement, formal inclusion of labor in the process will likely contribute to a better outcome.
- Once the mission, goals, and objectives are established; and policy and procedures are created, find opportunities where ACC personnel can use their skills and knowledge to act independently. Although consistency in action is important, allowing some ability for individual action promotes creativity and initiative.
- Finally, monitor progress regularly according to some commonly established metrics. In a perfect world, airport management will have chosen the right people for the team, implemented the correct technology, developed a workable mission statement, and developed clear policies and procedures. However, in the real world, management should verify that the team is working well together and that the ACC is accomplishing what was expected. This can be done by simply holding a quarterly all-hands meeting where ACC personnel can share suggestions, recommendations, concerns, successes, and even failures.

2.9 Data Management

Managing the data that will flow through the ACC is critical to ensuring that the data used is accurate, timely, complete, and, most importantly, not redundant or contradictory. The official definition provided by the Data Management Association, the professional organization for those in the data management profession, is: "Data Resource Management is the development and execution of architectures, policies, practices and procedures that properly manage the full data lifecycle needs of an enterprise."

Although an ACC initiative probably will not encompass a full data management exercise if one has not already been conducted at the airport, the ACC project management team can undertake several tasks to ensure that data management is carried out so as not to increase project risk. These tasks are as follows:

1. **Inventory all systems and databases that will be used in the ACC.** Identifying the system and each of its data elements is critical because this inventory is the basis for everything in data management. Once all of the data elements in every database are identified, each element should be named, defined, and its structure described (i.e., size and type), along with its source and how it may be used in output reports. For confidential or sensitive information, information about who may view and/or edit the data should be included. Typically, an Excel spreadsheet can be used to create this type of data matrix. If the airport has already engaged in sound data management practices, this inventory will have already been taken. For ACC purposes, it will simply be necessary to identify the data to be used in the ACC.
2. **Create an illustration depicting all of the types of data and how they flow through the ACC.** One of the more challenging aspects of data management in an ACC is the wide variety of data formats that will flow into the center. In addition to normal text data (e.g., email and data files), there may be recorded visual images from CCTV, recorded audio files from interactive voice response (IVR) systems, radio communications and telephone conversations, digital alerts from access control devices and other sensor information, incoming social media feeds, and even manually created meeting minutes and notes. Capturing how these disparate sources work together is a topic too broad for this Guidebook; however, an airport might find

that a rudimentary data architecture—in the form of an illustration depicting all of the types of data and how they flow in and out of the ACC—is a useful tool.

3. **Identify data owners.** All of the data flowing into the ACC must have an identified owner. In many organizations there is a data owner and a data custodian. The data owner is responsible for the accuracy, timeliness, and completeness of the data. Typically, the data owner determines who can have access to the data and how it may be used. In most organizations, the data owner is of a high level in the organization. For example, the director of Human Resources may be the data owner of all personnel data. Another individual, reporting to the data owner, is responsible for daily care and maintenance of the data—this is the data custodian. The data custodian is also responsible for working with all data users, the IT department, and most importantly, those entering data to ensure that all data quality standards are met. An airport may find that a formal data governance committee (composed of all data owners and custodians) where consistency on the use, maintenance, and access to data is agreed on is useful. Although this may be too much organization for a small or mid-sized airport, maintaining some semblance of data governance remains valid.
4. **Develop data retention policies and procedures.** The data lifecycle always includes cleansing or deletion of data when it is no longer necessary. An airport should have a data retention policy in place that identifies when a particular data element, record, or file may be disposed of. In most cases, this policy will be sufficient for the purposes of the ACC. In a few cases, an ACC will be storing data. One exception is if the airport has implemented a physical security information management (PSIM) system. A PSIM system is a category of software that provides a platform and applications created by middleware developers. This software is designed to integrate multiple unconnected security applications and devices and control them through one comprehensive user interface. It collects and correlates events from existing disparate security devices and information systems (e.g., video, access control, sensors, analytics, networks, and building systems) to enable personnel to identify and resolve situations. PSIM integration provides numerous organizational benefits, including increased control, improved situational awareness, and better management reporting. Ultimately, these solutions allow organizations to reduce costs through improved efficiency and to improve security through increased intelligence.[2] If the PSIM was implemented primarily for use by the ACC, storage of the data contained within it will likely be managed by the ACC and a determination will need to be made regarding disposal of routine data, and data that represents an incident that may have occurred and needs to be preserved for an extended period. In most cases, any data that could be the subject of litigation or continued analysis is kept indefinitely.

Section 7 discusses maintaining the security of information. Always maintaining a secure environment for data is important.

2.10 Implementing an ACC at a Small Airport

Although much of this Guidebook focuses on larger, multi-function ACCs, the basic approach, potential decisions that need to be made, broad range of functionality, are just as relevant to smaller airports. Developing a smaller ACC may not be commensurately easier than developing a large one.

Small airports will have fewer assets (e.g., funding and staff), less technology (and the IT staff available to support it), and less capacity to put necessary organizational infrastructure in place. Nevertheless, small airports can easily excerpt critical components from this Guidebook and use

[2]Wikipedia excerpt, dated April 5, 2017, from Physical Security Information Management system entry.

them in whole or in a reduced form. There is no reason why a smaller airport cannot develop and implement an ACC.

Smaller airports may experience some advantages in developing an ACC. First, it may be easier because of the reduced size. Second, fewer processes may be automated, or less complex IT systems may be in use. Third, because personnel in smaller airports often wear "more than one hat," training and integration of team members may be easier to accomplish.

The challenge for a small airport operator will likely be having the available internal resources necessary to complete the project. This challenge can be mitigated by acquiring external assistance or lengthening the project timeline to accomplish the project without overly taxing internal resources.

Section 5.9 outlines a sample ACC model for both a small and a medium-sized airport.

SECTION 3

Project Planning

To provide a controlled environment for a new or improved ACC, it is wise to create a formal project team who will be responsible for all aspects of the ACC design, CONOPS creation, construction (where necessary), installation and/or integration of new systems and applications, and especially for completing the project on time and within the allocated budget.

This Guidebook provides an overview of the project approach and topics specific to an ACC that will affect the project management plan. The project management approach will also vary depending on the size of the new or expanded ACC. For smaller airports, the defined process will be less formal and of a smaller scope. Every airport operator will need to determine how much emphasis to place in proceeding with a formal project management approach. However, it is safe to assume that more emphasis on a structured, logical method for managing the ACC development or expansion will correspond with reduced project risk.

Project planning is bridging the gap between the high-level vision and goals presented in the CONOPS (discussed in Section 4) and the details developed during design.

There are five traditional process groups in project management. Regardless of the size of the ACC or the project which is being used to create or expand the airport's center, each of these five groups should be used, at least to a minimal level.

The first group is Initiation. According to the Project Management Institute (PMI), initiation helps to set the vision of what is going to be accomplished. Key activities include

- Establishing project goals that align with the airport's strategic direction
- Selecting the project manager
- Identifying stakeholders

The second group is Planning. In the planning phase, staff develop the initial scope of the project. In this phase, critical project documents are developed. For an ACC, the most critical document is the initial draft of the CONOPS. Other documents and activities typically included in this phase are as follows:

- Scope document
- Work Breakdown Schedule
- Schedule development
- Procurement plan, where applicable
- Estimation of activity and associated resources
- Estimation of cost and determination of budget
- Initiation of the risk assessment
- Development of a quality assurance plan

The third group is Executing—this is actually accomplishing the work. In this phase, the project team accomplishes the deliverables as outlined in the project scope. Included in this phase are

- Budget monitoring
- Management of stakeholder input and requests
- Change management
- Management of communications
- Management of the project team
- Conduct of procurements
- Construction/renovation

The fourth group is Monitoring and Controlling. In this process group, the project team, according to the Project Management Institute's *Project Management Body of Knowledge* (PMBOK), tracks, reviews, and regulates the progress and performance of the project. Typically, this is the continuous review of cost, scope, and schedule. As much as airport management would like the project to remain true to the initial scope, budget, and planned schedule, there are always some deviations. In this phase, the project team's primary role is to mitigate the effect of changes on any of these three factors.

The final group is Closing. In this phase, the project is properly closed out. Activities include

- Formal acceptance
- Finalization and storage of documents
- Review of project performance
- Initiation of the CONOPS and ACC functionality

The remainder of this Section highlights specific practices in these process groups which are of most importance to an ACC project, irrespective of the project size.

3.1 ACC Project Management Practices

Creation of a project charter is a best practice in project management. In project management, a project charter (also called a project definition or project statement) is a statement of the scope, objectives, and participants in a project. The project charter provides a preliminary outline of roles and responsibilities, outlines the project objectives, identifies the main stakeholders, defines the authority of the project manager, and serves as a reference of authority for the future of the project.

A project charter should

- Contain the essence of the project
- Provide a shared understanding of the project
- Act as a contract between the project sponsor, key stakeholders, and the project team

Once the project charter is formalized, planning is initiated and includes the following:

- **Selecting a project manager to lead the effort for the airport.** This executive is charged with managing the process, assigning resources, and reporting to senior management. Project management is a key factor in a successful effort. The project manager needs to have the appropriate level of experience in terms of development and design, preferably working on communications or operations control facilities. Barring the availability of this individual within the organization, the airport operator may want to engage a PM from outside with knowledge and expertise in ACC-type projects. Key qualifications for the PM include a good understanding of airport operations and technology solutions, and good organizational and communication skills. This latter item is key in that the PM will serve not only as the source of information for the airport operator, but will also be charged with ongoing communication to and engagement with the stakeholders.

- Where construction is being considered, **identifying how to obtain architectural and engineering expertise, as well as a construction method**. Expertise and method may be internal or external or a combination thereof. Enlisting design experience is necessary to developing the ACC and should be considered early in the process. Many technical and design issues will be affected by the planning process, and it is most effective to have this expertise available during planning.

  This may be accomplished by

- Bringing in internal architectural, engineering, and technology experts to work through the ACC planning effort in advance of hiring a design team.
- Engaging external architectural and engineering expertise to assist in the formal planning effort. This group may or may not transition to the formal design process, depending on their expertise and availability and airport procurement policies for professional services. These resources should be qualified to address the issues specific to an ACC-type facility and be provided access to expertise, as needed, to support the planning effort.
- Establishing schedules and a roadmap for the development, with milestones and interdependencies identified. As planning progresses, this preliminary schedule can be refined and formalized with a fuller identification of the tasks for planning as well as design and construction requirements, along with milestones and interdependencies.
- Establishing a design document that describes, in detail, the technical aspects of the space and facility to guide the construction and implementation of the Center.
- Developing a communication plan outlining the types of communication, publication schedule, and distribution list that will be used to ensure that airport management and all stakeholders are kept abreast of project progress.

3.2 Establishing and Choosing the Project Team

Selection of a project manager to lead the ACC effort is one of the most important decisions that will be made during the initiative. The PM needs to have the appropriate level of experience in terms of development and design, preferably working on communications or operations control facilities. Barring the availability of this individual within the organization, the airport operator may want to engage a PM from outside with knowledge and expertise in ACC-type projects.

The following traits should be considered when selecting the PM:

- **Possesses expertise in project management as well as airport management.** Selecting a PM solely for their airport management acumen is not the way to complete a successful ACC project. The PM must have both project management skills and airport management experience in at least one of the functional areas being incorporated in the ACC.
- **Commands authority naturally.** If the ACC will be consolidating different organizations and the project team will consist of personnel who do not report together in the normal airport organizational structure, it is important to find an individual who can exercise authority without relying on the organization. (In project management terms, this is considered a matrixed organization and is discussed in more detail below.)
- **Asks good questions and listen to stakeholders.** A successful ACC PM will be interested in the opinions of the parties involved and will know how to channel communications to the stakeholders through the Project Communication Plan.

- **Uses consensus-building skills if conflict arises.** If the ACC will be bringing together airport organizations not previously co-located, there will likely be numerous opinions on how the project should be run, the expected outcomes, the use of personnel, etc. Irrespective of the PM's permanent position, the PM must be viewed as having the best interests of the entire airport as the manager the project.
- **Manages on a risk mitigation basis.** A good PM recognizes the potential for project risk before such risk occurs and responds accordingly and quickly. Managing with risk mitigation in mind is far more successful than trying to overcome growing obstacles through force of personality or throwing more resources at a problem.
- **Understands what incoming information is important and what can be ignored.** Knowing what can be ignored is especially important, given that there's usually an avalanche of data, opinions, suggestions, and recommendations in any large-scale project.

An ACC project is likely to draw project team members from throughout the airport so as to take advantage of the combined skill and expertise of the airport staff. In project management, this is referred to as a "matrix organization," and it has specific issues that need to be considered.

Matrix management involves coordinating, organizing, and executing a potentially complex web of relationships that come about when staff from various groups join a project team and are subject to the resulting multiple authority/responsibility/accountability relationships in the organization. A matrix project management team's goal is to take advantage of the benefits of a project organization while maintaining the advantages of the functional organization.

In a matrix project management organization, a clear project team is established that crosses organizational boundaries and team members will come from various airport groups. As discussed in Section 3.4, a project manager is selected who will manage the ACC project. The challenge for the PM is that the project team members will be directed by the PM in project-related duties; however, they will also still report to their functional departments and maintain responsibilities for routine departmental work in their functional areas.

The existence of a matrix organization affects almost every aspect of the project management plan, from selection of the PM to scheduling to human resource management and must be considered by management when conceptualizing the ACC development.

3.3 Project Management Plan

Irrespective of the size of the airport or the projected size of the ACC, a project management plan, including a project schedule and budget, is important to maintaining a disciplined project approach. A detailed project management plan significantly increases the likelihood of completing a successful project.

A **project management plan**, according to the PMI PMBOK, is ". . . a formal, approved document used to guide both *project execution* and *project control*." The primary uses of the project management plan are to document planning assumptions and decisions, facilitate communication among *project stakeholders*, and document approved scope, cost, and schedule *baselines*. A project management plan may be summarized or detailed.

An airport operator must decide which elements of a traditional project management plan should be included, usually depending on the size and complexity of the final center design. A comprehensive project management plan that follows industry standards (e.g., the PMI PMBOK) must describe the execution, management, and control of the project. Additional documents to consider may be a procurement plan or construction plan, or they may be detailed in the project management plan.

The project management plan typically covers topics used in the project execution system and includes the following:

- **Scope and requirements management.** For an ACC, the scope is primarily identified in the CONOPS and the design document. Once the CONOPS has been reviewed and approved by management, the scope must remain stable, unless a glaring omission is uncovered and management amends its original approval. Similarly, the design document needs review and approval by management, along with amended approval for any major changes. Adding to scope after the schedule and budget have been determined will lead to schedule delay and cost overruns and can threaten the success of the project.
- **Schedule management.** This includes developing a project schedule—this may range from a detailed project timeline, using a product such as MS Project, to a simple listing of critical project milestones. The granularity of the project schedule should reflect the size, complexity, and length of the project.
- **Financial management.** A detailed cost budget, reflecting management's financial commitment to the project and corresponding to the goals and objectives of the project, must be established at the onset of the project. Detailed accounting for expenditures is necessary to ensure that the project stays within its projected cost.
- **Resource management.** One of the most critical aspects of developing an ACC is proper resource management, particularly human resources. Typically, the project team will consist mainly of employees from airport operations, IT, and law enforcement. These employees already have full-time positions and may frequently find themselves pulled between ongoing duties and the ACC project. Consideration must be given to this dual responsibility to ensure that neither objective is significantly affected.
- **Communications management.** Developing a communication plan outlining how users, stakeholders, and management will be kept informed of project progress is essential. The following should be considered:
  - The responsibility for transmitting the information
  - Critical information on product progress
  - The intended audience
  - The timing of communication efforts
  - The communication format
- **Project change management.** This element helps ensure that the schedule does not change without notification to management and that every possible effort is made to keep the schedule on time and the budget projections intact.
- **Risk management.** No matter how small or large the ACC project, risk management should be undertaken. A simple risk management table identifying all possible obstacles to successful completion of the project, the likelihood of their occurrence, the potential effect of the risk should it occur, and possible mitigation efforts should be developed. Looking at potential obstacles early in the project helps to ensure that the schedule and projected cost are reasonable.

3.4 Project Scheduling

Answering "when?" is critical in planning a successful ACC. The timing of the development of a communications center may be contingent on other airport projects or it may be a standalone project. Having a clear desired projection for completion that is flexible enough to (1) allow full testing and training and (2) ensure that any support applications are fully ready to be integrated into the ACC based on the desired opening is essential. The most likely factor in an unsuccessful project is an over-optimistic view that everything will go perfectly with the schedule developed on the basis of that unlikely occurrence. The following factors may be involved in even the smallest communications center project and must be considered when developing the project schedule.

- **Availability of Critical Staff.** The availability of airport experienced subject matter experts is critical to the successful development of the ACC. However, these are the personnel who are the most likely to be involved with other ongoing initiatives and are critical to daily operations. Scheduling concessions must be built in to realistically reflect the amount of time such staff can offer during the project.
- **Effect of Other Major Activities.** If construction or the acquisition of new technology is needed for the ACC, a full separate planning process for each of those two activities will be likely. If both activities are necessary, then there will need to be an integrated plan between construction and technology. These two activities are often difficult to plan in tandem. Each has its own set of risks, unique to the respective environment. Integrating these two schedules into the overall project schedule is a challenge. A clear, unbiased approach, without the pressure of arbitrarily set completion dates, is essential in ensuring a successful project.
- **Procurement Activities.** Another activity that must be considered, where appropriate, is procurement. As with construction and IT, procurement requires a specialized process and specific steps that must be accomplished. A procurement specialist should participate in developing the project schedule to ensure that the total plan is reasonable and can be accomplished and meet all procurement requirements.
- **Training Activities.** Stakeholder and user training is often overlooked and typically given too little time when scheduling a project. Depending on how much the new ACC will change the operating environment of the airport, training is essential to a smooth, successful launch. Training will likely consist of (1) operational training related to the new functionality of the ACC, (2) application training on any new technology being implemented, and (3) training on any new processes and procedures that may be implemented. It is also wise to have internal meetings with all future ACC personnel, especially where organizations not previously co-located in a common space are coming together. Ensuring that everyone understands their specific role is important in establishing a new airport operational approach.

3.5 Project Work Breakdown Schedule

A basic project management document that an airport team may develop when implementing an ACC is a work breakdown structure (WBS). Used in project management, a WBS is a project deliverable that organizes the project team's work into manageable sections. The PMI's PMBOK defines the WBS as "A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables."

A WBS illustrates the project broken into phases, deliverables, and work packages. It is an inverted tree structure, which shows the subdivision of effort required to achieve an objective. For an ACC, the WBS is developed by starting with the ACC and successively subdividing it into manageable components (e.g., each function that will be contained within the ACC) that are then further broken down by responsibility, systems, and tasks.

Once completed, the ACC WBS is important for describing to management, stakeholders, and external parties, the approach being used to implement the ACC, the resources needed, and the functionality of the center once it is completed.

3.6 ACC Funding

Committing the necessary resources for the entire ACC project is important. An ACC can be an expensive undertaking and providing a rough order of magnitude of the necessary resources up front helps to frame the final requirements for the ACC. Committing necessary resources includes funding for project management, personnel, integration of existing and planned infrastructure, architectural components, coordination of planning and design, and other locally unique activities and assets to be accommodated for the project to move forward. Costs will generally include

- A rough order of magnitude (ROM) of "soft" costs (e.g., planning, design, and consulting fees) required to develop the project.
- A similar ROM of "hard" costs (e.g., capital expenses for construction of facilities, IT and communications infrastructure expansion, equipment, labor, and related costs).
- Internal and external professional resources necessary to complete and support the project, such as maintenance and training.
- A proposed schedule of steps to be undertaken throughout the process, along with milestones to be accomplished.

3.6.1 External Funding for an ACC

Every state has one or more agencies planning for public safety, homeland security, and emergency communications. Federal, state, and local grant programs tend to fund at the county levels where decision-making is frequently determined by function and coordinated through a single office or planning boards. Funds, as well as authority, are therefore disbursed according to the administrative structure of the county, city, town, parish, or independent city with numerous variations. The Bureau of the Census identifies 3,143 U.S. counties and county-equivalents that could obtain federal, state, and local grants for public safety, homeland security, and emergency communications; however, U.S. airport operators generally operating within municipal and county jurisdictions have infrequently applied for these program funds.

Appropriations from state and local budgets, government bond financing, private foundation grants, lease-purchase agreements with equipment suppliers, recurring revenues (e.g., fines, user fees, and surcharges), and state/local sales and property taxes are among the most common sources of funding for communications projects nationwide. Communications center capital expenditures for facilities, equipment, and systems (including network fiber-optic or microwave backhaul), lifecycle costs for operations, maintenance, training, upgrades, and other recurring expenses, are the most frequently funded efforts.

Public-private partnerships could better capture innovations and cost-saving economies of scale more regularly than one-time transactions. Other sources of funding for building and operating communications systems are available to states and communities. DHS, FEMA, and the Office of Emergency Communications manage statewide planning and coordination for interoperable communications in compliance with the National Emergency Communications Plan.

The Association of Public-Safety Communications Officials (APCO) provides public safety communications expertise, professional development, technical assistance, advocacy, and outreach and has established the Public Safety Foundation of America (PSFA), a 501(c)3 non-profit subsidiary that funds "new or ongoing projects for the betterment of public safety communications, including initiatives to improve the overall quality" and to educate public safety agencies and other stakeholders. PSFA, following its establishment in 2002, provided five rounds of grants delivering more than $13 million to over 200 agencies in 40 states and continues to provide funding to eligible applicants.

ACC considerations (including cost estimates, revenue sources, jurisdictional issues involving governance, decision-making, spectrum management, and technology) may still be inadequate to achieve "desired levels" unless the airport's CONOPS envisions interoperability. The Federal Communications Commission (FCC) advocates deploying Internet Protocol (IP)-enabled technologies for (national grid) *NG9-1-1* and wireless broadband networks. This is in harmony with recent airport trends in seeking common IP-enabled platforms. IP-enabled platforms that can operate on any IT-enabled networks and/or IP-enabled wireless devices using technologies such as Long-Term Evolution are expected to deliver advanced services anywhere at any time and should be particularly appealing to airport operators hoping to maximize legacy system lifecycles.

3.6.2 Interoperability Opportunities Affecting Funding

The Public Safety Interoperability Grant Program is available to any state with a DHS Office of Emergency Communications Statewide Communication Interoperability Plan (SCIP). FEMA is tasked to establish Regional Emergency Communications Coordination (RECC) Working Groups for fund eligibility. The RECC mission is to "establish and use the RECC's as a single federal emergency communications coordination point for federal interaction with the state, local and tribal governments" and to coordinate with others—such as airports—as appropriate.

3.7 Project Risk Assessment

Developing a project risk approach is essential to every ACC implementation. Even for the smallest project, a realistic look at obstacles to progress is essential. A typical project-oriented risk structure can be used to identify potential threats to proper project completion, effect level, likelihood of occurrence, and mitigation steps.

The following steps should be included in every risk management effort:

- **Identify Risks Early in Your Project.** The first step in project risk management is to identify the risks in the project. This requires an open mind that focuses on future scenarios that may occur. Two main sources exist to identify risks—people and paper. People are primarily the ACC team members who each bring their personal experiences and expertise. The second is the project plan, including details on timeline and budgeting. An unreasonable project completion date or insufficient resources easily become a risk, given the resulting influence on project execution.
- **Create a Register for Project Risks.** Documenting the perceived project risk is an essential communication mechanism that informs airport management, the project team, and all stakeholders about issues that could affect the project.
- **Analyze Risks.** Understanding a risk is a precondition for a good response. Therefore, take time to examine individual risks and do not make conclusions without knowing what a risk is about. Performing a detailed risk assessment is critical to a healthy risk management program.
- **Prioritize Risks.** All risks are different in effect, likelihood, potential cost, and mitigation efforts. It is important to prioritize risk and pay close attention to those items that rank highest on the risk register.
- **Communicate Risks.** A good approach is to begin by sharing a risk register with airport management and then including risk communication in every team meeting with project risks as part of the default agenda. This shows risks are important to the project manager and gives team members a natural opportunity to discuss them and report new ones.
- **Clarify Ownership Issues.** Some project managers think they are done once they have created a list of risks, but this is only a starting point. The next step is to make clear who is responsible for each identified risk.

S/No.	Risks	Probability (1=low, 5=high)	Impact (1=low, 5=high)	Risk Category	Ranking of Risks
1	Lack of employees	1	5	Low probability, High impact	2
2	Unable to find a suitable workplace	4	5	High probability, High impact	1
3	Unskilled contractors found	1	3	Low probability, Low impact	5
4	Delay in the arrival of materials and equipment	2	3	Low probability, Low impact	4
5	Delay in the completion of prototype	2	4	Low probability, High impact	3

Figure 3-1. A typical risk assessment format.

- **Plan and Implement Risk Responses.** Implementing a risk response is the activity that adds value to a project. By responding, the organization prevents a threat from occurring or minimizes negative effects. Execution is essential here. While other rules have helped the organization to map, prioritize, and understand risks, execution will help the organization make a sound risk response plan that focuses on the most important issues.

Figure 3-1 presents a typical format for a risk assessment.

SECTION 4

Concept of Operations (CONOPS)

4.1 Concept of Operation

Two critical documents are created when developing an ACC. One is the CONOPS—the recommended planning tool for identifying the scope, breadth, and functions to be contained within the proposed ACC.

A **Concept of Operations** is a document outlining the characteristics of a proposed organization, function, or system from the viewpoint of the stakeholders who will use that organization, function, or system. A CONOPS is used to communicate the quantitative and qualitative characteristics to all stakeholders. The CONOPS evolves from an organizationally derived concept statement based on the specific environment and describes how a set of capabilities may be used to achieve desired objectives. The CONOPS is a permanent document and will evolve with the ACC over time. The CONOPS will seek to describe the following:

- The problem being addressed
- The mission
- Management intent
- An operational overview
- The objectives to be achieved
- Descriptions of each individual function performed in the ACC
- The roles and responsibilities of tasked organizations

The CONOPS provides an excellent communications tool between management and staff. Initially, the CONOPS is created to express the needs and goals of the stakeholders to the project team. Subsequently, the developers create or update the CONOPS to communicate the early design possibilities to the users for review and approval. In most successful projects, the CONOPS is updated throughout the development cycle and becomes part of the operations and support documentation.

As discussed in Section 3, the second document created during the development of an ACC is a project management plan for the actual design, development, and implementation of the ACC. The project management plan is a temporary document, created for the duration of the project, and is archived as part of project closeout. However, elements of the CONOPS and the project management plan are similar and much of the documentation generated by the airport team will be used in both documents.

A CONOPS need not be complicated, long, or complex, but it should be tailored to the size of the airport. Smaller airports may choose to perform all of the steps listed below or only those that airport management deems pertinent to the effort. Larger airports will likely have a more in-depth document, but, again, the airport operator should choose those aspects of creating a CONOPS most applicable to the intended situation. For all sizes of airports, the most important input comes from the airport. A CONOPS can be created with outside assistance, but, in almost all cases, an airport can develop the basic CONOPS with its own internal resources.

Three critical documents will emerge from this exercise: (1) the CONOPS; (2) a situational awareness template outlining situations that require special handling by the ACC; and (3) a policy and procedures document (see Section 2). Additional information on the policy and procedure document should be provided in this Section as well.

4.2 Basis for ACC Development

As discussed throughout this Guidebook, six questions are asked as the ACC initiative is carried out: "Why," "What," "Who," Where," "How," and "When." Answering "why", "what," and "who" helps in developing the CONOPS.

Typically, the first question addressed is "why." This is the first question answered when developing the CONOPS. Airport management will have many reasons why an ACC should be created and an explicit, clear description of the justification is a critical first step. It is likely that the answer to "why" will be used as a factor in all future decisions.

Determining the drivers for creating an ACC is crucial and will help address other issues. For example, has there been a perceived need—based on past issues—or is the goal to better manage a planned airport expansion/growth projection? Are there regulatory requirements that must be addressed or is this an opportunity to have better situational awareness on which to make operational decisions?

"Why" is typically first asked at the executive or managerial level. This is important because it helps to ensure management support for the effort will reflect the full organizational view of the facility and will provide an opportunity to examine issues that may have competing priorities (e.g., budgetary constraints or managerial conflicts). If top management is NOT asking "why," strong consideration must be given as to whether or not an ACC will be a viable project. Once the CONOPS Team understands the perspective of top management, it can then further develop the "why" answer to fit other organizational units.

4.3 ACC Functionality

Asking "what" helps to identify the depth and breadth of functionality the ACC must accommodate to meet the desired needs of the airport operator. This is usually expressed in a mission statement and may include such items as

- What array of services is the facility expected to offer?
- What information does the airport operator believe is necessary for obtaining the situational awareness it is seeking?
- What are the potential constraints on developing an ACC?
- What are measurements for success in the ACC effort?

"What" will be asked repeatedly throughout the CONOPS process.

4.4 ACC Users

"Who" is asked when (1) putting together a project team responsible for planning, designing, and implementing an ACC, and (2) determining the permanent "residents" of an ACC. "Who" addresses the identity of stakeholders (e.g., individual or organizational, internal or external to the communications center). When determining external users, the CONOPS should reflect all potential users of the ACC and whether they are outside departments or agencies interfacing with the airport or indirect beneficiaries (e.g., airlines, tenants, passengers, or other users in an airport who may benefit from a communications center). This initial assessment will address the ACC's users at a high level, at minimum as classes or descriptions of users who are meaningful to the organization.

The concept of an integrated communications center facility is not new. Facilities of this type have been established in the airport environment for years and typically grow organically over time, assuming more responsibilities to best serve the needs of the airport operator.

Although the idea behind these centers is simple, the integrated approach does not necessarily come easily. Entities and organizations functioning autonomously do not always see the need for or understand the benefit of close cooperation with others. This situation is often complicated by incompatible technologies and procedures, staff operating near their limits, and constrained resources and budgets.

Bringing multiple disciplines with diverse operational goals into one work area for daily operations can improve the response and efficiency of most airports. When departments engage each other, individuals gain a better understanding of each department's responsibilities and objectives. Close communication improves situational awareness which produces faster and more efficient management of daily operations and issues. The effect is similar to how airports use the EOC during large events—Constant, close interaction to improve communications and response during any range of events. Bringing the appropriate people and technology together also helps an organization begin to respond actively, rather than reactively.

Bringing people and their unique interests together is the first step, whether this is achieved through physical presence or remote communications (e.g., the Internet, phones and/or radios). The second step is to provide people with an operational plan that maximizes effectiveness and delivers the greatest value to the airport.

Many stakeholders are associated with an ACC/AOC. Primary departments, stakeholders, and/or functions, as well as Secondary and Exterior stakeholders are described below. These descriptions introduce the reader to potential interactions with other participants, either physically co-located or via remote communications, for information exchanges.

Primary departments that may be physically in the center include

- **Communications Dispatchers.** Functions may include dispatching key airport personnel (e.g., police, fire, medical, operations, and maintenance). Dispatchers may also monitor security and dispatch a responder to alarms, particularly at the screening checkpoint and operational doors. Dispatchers monitor security closed-circuit TV (CCTV) cameras, handle call-taking/call triage, initiate maintenance request orders, make airport pages, and help with other airport information requests and with all daily activities logged. Ideally, everyone associated with or having regular contact with the center works from the same integrated logging system, so that reports can present a holistic picture of the airport's activities.
- **Airfield Operations.** Functions within the center may include monitoring the airfield for FAR Part 139 issues, advising and assisting operations staff to respond to airside issues/events, initiating maintenance work orders for airfield issues, issuing Notice to Airmen (NOTAMs), and responding to irregular operations (IROPS) and emergencies.
- **Landside Operations.** Functions within the center may include monitoring airport terminal and curbside/roadways issues, advising and assisting operations staff to respond to landside issues/events, initiating maintenance work orders where required, monitoring terminal activities to ensure public and sterile areas are properly maintained, and responding to irregular operations (IROPS) and emergencies.

- **Airport Security.** Functions within the center may include monitoring pedestrian and vehicle doors' and gates' checkpoint alarms, assisting with response to security issues and emergencies, and coordinating with TSA and the badging office.
- **Law Enforcement Officer (LEO) Dispatcher.** Functions within the center may include dispatching police, monitoring patrols, and assisting with resource requests when necessary.
- **TSA.** Functions may include working with communications center staff to monitor checkpoint alarms and door response, monitoring security checkpoints and adjusting staffing as needed, and working with airport personnel during emergencies.
- **ARFF Dispatchers.** Functions within the center may include dispatching ARFF and medical response, monitoring responses, and coordinating resource requests when necessary.
- **Maintenance Functions.** Maintenance functions include managing maintenance work order requests and monitoring environmental factors, power systems, moving walkways/escalators/elevators, baggage handling systems, and building maintenance systems.
- **Paging/General Information.** This function may be one of several collateral duties of a dispatcher or may be a standalone position and may include call-taking/call triage, airport pages, response to tenant and public inquiries, and managing lost-and-found items, among other ancillary tasks.

Secondary departments are those having regular contact with the ACC but that may not be in the same facility or local area:

- **Law Enforcement Officers.** They communicate with the ACC when responding to an event and provide information concerning continuing response, on-scene activity, unattended bags, suspicious items or persons, or other unusual circumstances.
- **Public Affairs.** Staff contact the ACC regularly for operational information, particularly during IROPS and emergencies. In today's social media world, the public affairs office can both provide and acquire information rapidly from people with access to real-time monitoring of radio/phone traffic and CCTV.
- **TSA.** During a checkpoint security event, door alarm, or other suspicious activity, TSA can have quick access to airportwide information from the ACC, including real-time monitoring of media and other external communications resources.
- **FAA.** Air Traffic Control typically works with the ACC during aircraft alerts/emergencies, dealing with issues affecting the movement of aircraft (e.g., a security breach in the terminal or delayed arrival or departure of aircraft).
- **Customs and Border Protection (CBP).** CBP often works with the ACC to ascertain information on travelers or aircraft movements or to request additional resources during emergencies.
- **ARFF.** Similar to Law Enforcement response, ARFF personnel will communicate with the ACC when responding to an event, when on scene, and when they have returned to station.
- **Airlines.** Airlines often call the ACC for information on issues affecting their flights, to help with expediting a security or emergency problem, and to request support resources. (Note: At some airports, airlines may be a primary user of the ACC.)
- **Concessions.** Concessions may call the ACC for information on IROPS or issues affecting their businesses and to request resources.
- **Maintenance Trade Departments.** Maintenance trade departments regularly interact with the ACC concerning maintenance request status or when additional resources are needed.
- **Parking.** Parking staff may request help from the ACC in the event of public or passenger issues (e.g., someone locking themselves out of the car), determining if the lots are full, or to report an issue or event.
- **General Aviation (GA) Fixed-Based Operators (FBOs).** The FBO, and in many cases the GA aircraft or pilot, may communicate with the ACC to seek local information or for assistance such as ground handling or disabled aircraft removal.

- **Aircraft Service Operators (e.g., catering, ground service, fueling).** Personnel may be in contact with the ACC for issues affecting ramp operations (e.g., lightning, fuel spills, or unauthorized activity).

External Stakeholders are those not within the airport organization or boundaries, but having regular contact with the ACC:

- **Mutual-Aid Responders: Police, Fire, Medical Personnel.** The ACC is a liaison between mutual-aid responders and on-airport responders when additional resources are requested. The ACC may provide communication among staging areas or radio channel assignments between field staff and mutual aid and may also track and log responders' requests.
- **General Public.** The general public may contact the ACC for general information (e.g., airline schedules, parking rates, and hours of operations) or to make an aircraft noise complaint.
- **Federal Agencies.** The FAA's Flight Standards District Office may be in contact with the ACC in the event of an aircraft incident or accident. Such staff may be first on the scene to begin investigation of an accident, pending any National Transportation Safety Board response.
- **Public Safety Answering Point (PSAP/911).** Many ACCs coordinate with the local PSAP organization when additional police, fire, and mutual aid response is requested or if an event (e.g., a car chase off airport) involves airport property and airport LEO response/support is requested. In many airports this coordination is so important that recorded call-down lines are installed in both centers for rapid communication and coordination.
- **City/County Emergency Management.** The ACC may be involved on behalf of the Emergency Operations Staff during initial stages of an event to request resources or if an event is community wide; the City/County Emergency Management Team may request airport resources or facilities to assist with the event.
- **Federal Bureau of Investigation (FBI).** Initial coordination with the FBI early in an event (e.g., a reported aircraft bomb threat, sabotage, or other terrorist activity) may be initiated through the ACC.
- **American Red Cross (ARC).** In the event of a multi-casualty event, the ACC may request a response from the ARC.
- **Hospitals.** The ACC may coordinate with hospitals, clinics, and other medical facilities to facilitate patient movement during emergencies or to help track the movement and status of patients. The ACC often assist with communications among Police, ARFF, airport and airline management, and the EOC or Field Incident Command staff if needed.
- **Centers for Disease Control (CDC).** The ACC may make initial contact with the CDC in the event of a suspected pandemic event or suspicious illness of persons at the airport.
- **Weather Forecast Stations.** The ACC may contact local forecasters for briefings on imminent severe weather conditions in support of airport operations or the EOC or in preparing for support during anticipated extraordinary conditions (e.g., tornadoes or icestorms).
- **Local, State, or Federal Elected Officials.** Elected officials often have an interest in the ongoing operations of an airport, especially where it is the primary transportation node for the community.

This list is by no means comprehensive or complete; it merely outlines the considerable number, range, and types of functions that may be a part of the ACC's daily sphere of activity, both in normal and abnormal conditions. Although the ACC may be an extremely important core asset in service to the surrounding community, it is still primarily an airport facility serving airport functions, and it is the airport's jurisdiction and responsibility to determine the ultimate composition of resident and non-resident users and how each user will be accommodated.

In every instance, both for primary and secondary stakeholder interests, it remains the airport's sole jurisdiction and responsibility to determine, during the development of the CONOPS, the combination of users and user requirements most beneficial to the airport operator's best interest and to prioritize those elements within the available space, budget, and manpower parameters.

Additional important benefits to identifying the intended stakeholders are to

- Provide the initial identification of the personnel and number and type of functions that will either be in the facility or interact with it in some form
- Identify the level and priorities of personnel or organizations that will be engaged in the process during design and development
- Identify the roles and responsibilities of the stakeholders with a definition of their operational interactions, both internal and external

4.5 Initiating the CONOPS Process

The first step in initiating the CONOPS process is for airport management to select the airport personnel who will be responsible for CONOPS development. The CONOPS Team may be a subset of the project management team or may be the project management team. Whether the CONOPS Team is the same as the project management team or a subset of the project management team is usually decided based on the breadth and scope of the proposed ACC, whether or not construction is involved, and how many new systems and applications are being considered for the proposed ACC. Representation from the IT group is essential if new systems are being contemplated or if a change to existing systems is anticipated.

This team should represent all elements of the airport organization, including members who are not likely to have ongoing representation in the ACC. It is especially important to include both the airport's IT team and a representative from Human Resources. The presence of such groups will help ensure that the rest of the airport is fully aware of the ACC's mission, goals, and objectives, and will garner support early on airportwide. The ultimate goal of the CONOPS process is to have sign-off from airport management and all included stakeholders. The CONOPS signifies acceptance of the proposed scope and breadth, as well as support for the project as a whole.

4.6 Undertaking the Full CONOPS

Guidance literature on developing a CONOPS is available (see Appendix A). The guidance generally follows similar developmental paths, even in fields other than transportation, with variations that define numerous possible scenarios and approaches to their resolution—none are "wrong". They are simply different ways of reaching the same goal. This Guidebook outlines one method for completing the CONOPS, the resources needed, and a recommended format.

CONOPS development is iterative, both in initial project development over the long term. The initial CONOPS will continue to be expanded as the project team investigates airport functions and determines whether or not these functions should be included in the ACC. These decisions and determinations will be reflected in the official CONOPS.

As with any business or project analysis, the CONOPS Team will compile numerous opinions and suggestions. Capturing as much input as possible is desirable because, although it may not be possible to include all stakeholder concerns in the current cycle, opportunities to include additional ideas may arise as the ACC is expanded.

4.6.1 Basis for Developing an ACC

The CONOPS Team takes a second look at the initial justification for developing an ACC. If the justification has changed or become clearer, this section is updated to reflect the latest catalysts for ACC development. This justification is used as one of the metrics to assess the success of the ACC project.

The basis for developing the ACC provides a point of reference for the planning and design team and enables the team to (1) assess design solutions in terms of whether they meet the intent of the CONOPS and (2) identify evolving concerns that may require adjustment to the CONOPS and the resulting planning decisions.

4.6.2 Functionality

The CONOPS Team will now identify, in detail, all of the functions the ACC is expected to manage and the desired outcome from each of those functions. The CONOPS Team will focus on the data to be collected and the resulting information that will be necessary to provide situational awareness and meet the ACC's communication objectives. If specific systems are obvious resources to answer these questions, they can be identified; however, for the CONOPS, it is not necessary to define specific software products or vendors.

Key factors include detailed descriptions of the types of systems and services required for the ACC and its proper operation. Later there will be a need to identify any system or service constraints resulting from requirements for integration with legacy systems. This portion of the CONOPS provides a starting place for the development that will occur during the planning and design phases that follow.

4.6.3 Stakeholders

Stakeholder engagement is essential in developing facilities and systems in airports. Unless airport management and staff are fully engaged, it will be difficult to develop operational requirements, which is the goal of a CONOPS.

During development, stakeholder engagement presents four challenges:

- Identifying the individuals and organizations that constitute the stakeholder community. Stakeholders can be defined as virtually any parties who have, or may have, an operational or business relationship with the airport operator. This may include a relationship to a specific function or facility (e.g., an ACC) and may also include a broad range of users who operate, use, rely on, manage, and/or support the facility.
- Obtaining the active involvement and approval of top management. Given that top management consists of the ultimate decisionmakers, master planners, and controllers of the budget, and thus are the ultimate authorities on what plans will move forward, when, and under which department's jurisdiction, involvement and approval by top management is critical. An ACC can have many stakeholders, given the range of functions it fulfills, and all stakeholders may not have equal influence. These stakeholders can include operations (both landside and airside), security and safety services, maintenance, IT systems, airlines, tenants, service providers, transportation agencies, and the public.

If the number of stakeholders is too large for effective communications, two approaches may be taken to manage this situation:

1. Working with smaller, break-out teams, and/or
2. Identifying key stakeholders to act as leads for a related group of stakeholders. (For example, in break-out teams, one individual might represent the operational side of the airport, with the understanding that the individual will communicate with their broader community.)

- Establishing and maintaining effective communication with the stakeholders. For stakeholders to be useful to development, they must be engaged in a significant way. This means being conscious of their time and availability, maintaining open and transparent communications, and providing background information and identifying needs for input in a clear and timely manner. Stakeholder participation can be conducted through written questionnaires, individual meetings, and group sessions, whether for briefings, question and answer, or brainstorming. Brainstorming and free-form conversations, whether in a large forum or one-on-one, can be productive and should be considered as a reasonable part of stakeholder engagement.
- Integrating stakeholder input in a meaningful way. One of the most challenging parts of stakeholder engagement is finding the balance between empowering and encouraging the stakeholders while weighing the value of their input.

Do not dismiss or diminish a stakeholder's ideas and suggestions out of hand. Doing so sends a message that the stakeholder engagement effort is not valuable, and the damage this can do to ongoing and future efforts can be long lived. Listening to and respectfully acknowledging the stakeholder's interest is, therefore, essential.

However, all stakeholder input is not equal. For various reasons, some input may be inappropriate or impractical under the prevailing conditions. Consider whether these conditions need to be adjusted; however, the key individuals responsible for stakeholder engagement and the processing of their ideas need to provide a degree of filtering. When a stakeholder's ideas are not incorporated, individuals responsible for stakeholder engagement should discuss the reasons for this decision with the stakeholder. Some ideas may be incorporated in the future.

Stakeholders are not only a valuable resource to the team developing an ACC—stakeholders are the community of daily users of the ACC's services and information. Stakeholders are critical to identifying many of the needs, goals, and objectives that will ultimately be included in the CONOPS. Stakeholders are also typically in a position to identify what works and what does not in an existing facility. Further, with proper engagement, they can provide useful insight into why things work well or not and suggest ways for addressing issues.

4.7 CONOPS Structure

The CONOPS will have the following sections:

- Executive Summary
- Mission Description
- ACC Operational Context and Architecture
- Organizational System Drivers and Constraints
- Center Functions
- Operational Scenarios, including the situational awareness template
- Implementation Concepts and Rationale
- Proposed ACC Operational Architecture
- Organizational and Business Impact
- Risks and Technology Readiness Assessment

Appendix B has a sample CONOPS template.

4.7.1 Executive Summary

A CONOPS Executive Summary is usually a short overview of the operation, mission, and objectives developed for the ACC. An Executive Summary, usually around two pages in length, should be used to summarize the CONOPS purpose, including any key decisions required or made. The Executive Summary focuses stakeholder attention on the most important aspects of the CONOPS document and provides sufficient information for the executive decisionmaker to understand the purpose and contents of this conceptual document.

4.7.2 Mission Description

The Mission Description is an overview of the goals and objectives, underlying mission and business rationale, the current (As Is) Architecture, a list of key stakeholders and expectations, and the current gaps in capabilities that require resolution. The Mission Description also looks at the future of the ACC and begins to lay the framework for potential expansion of the ACC as the mission evolves.

4.7.3 ACC Operational Context and Architecture

The ACC operational context clarifies the boundary of the center as it is being conceived. In this section, the following six components are created:

- Current functional components of the ACC.
- Current organizations, roles, and responsibilities.
- Current policies, including regulations, procedures, and standards of all entities that may govern activities in the ACC, including the airport, FAA, and NIMS.
- Projected ACC performance drivers.
- Existing communication protocols and standards and intended modifications.
- Current and projected personnel numbers, skills, and competencies.

This section also outlines what the ACC is NOT going to do and what is expected of other airport organizations and those organizations external to the airport.

4.7.4 Organizational Drivers and Constraints

The CONOPS should (1) identify aspects of the current airport operational environment that constrain the proposed ACC and (2) drive the decisions as to which functions are incorporated into the ACC. To ensure that correct functions are chosen and achievable, the ACC should be considered in light of the following:

- The current airport operational approach, including relevant policies, regulation, and operation procedures.
- Legal requirements or regulations for privacy, security, and safety.
- Organization or Airport board mandates (where relevant) as well as the roles and responsibilities of external organizations that help realize the ACC mission's goals and objectives.
- Operational elements already adopted in the airport to improve performance that will be carried into the ACC intact.
- Current operational and support resources, as well as systems and infrastructure constraints.
- Skill levels and competencies of available airport SMEs and support people.

4.7.5 Center Functions

The heart of the CONOPS is the detailed description of each function being carried out in the ACC. This is one page (more if necessary) that describes each of the ACC's functions. Typically, an airport operator creates its own function template and uses the same template for each function. It is likely that there will be functions within functions, so it is necessary for the airport to develop a standard work breakdown structure (WBS) as often found in project management texts, such as the PMI PMBOK. The PMBOK defines the WBS as "A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables." This definition can be used for ACC operations as well by defining the actual functions that will be carried out within the ACC organization.

Each function or element in the WBS, will have the following components:

- A title.
- A detailed description of the function.
- Other functions that may be related.
- Information inputs to the function (e.g., electronic, reports and regularly scheduled meetings).
- All outputs from the function.
- Constraints or obstacles that affect the function.
- The primary manager of the function and the reporting structure.
- The roles and responsibilities of all airport staff responsible for the proper execution of the function.
- The intended outcome of the function.
- Performance metrics that measure a successful outcome for the function.

As the ACC evolves and functions are added, subtracted, or amended, the CONOPS Functional Statement must be revised accordingly. Appendix C is an example of the ACC Functions Template.

4.7.6 Operational Scenarios

Scenarios are a major part of any CONOPS. Operational scenarios are impactful situations that will affect the ACC's normal operations and will require special handling or triage of some sort. The classic way to develop a set of scenarios usually involves gathering a group of subject matter experts (SMEs) and having them use their experience to make a list of potential scenarios that could affect ACC operations. Selection criteria are then applied (although it is usually "engineering judgment" or "a gut feeling") to determine which scenarios should be included in the CONOPS. Irrespective of how the operational scenarios are developed, the outcome is that the airport management team discusses a specific response to each scenario. Because anticipated operational scenarios oftentimes closely resemble actual scenarios, but are not exactly the same, it is wise to include areas where ACC personnel can exercise their own discretion, along with limitations on that discretion.

4.7.7 Implementation Concepts and Rationale

Most ACCs initially start by upgrading, evolving, or leveraging existing communication systems or protocols. Generating entirely new solutions may seem radical and innovative, but increases project risk and must be addressed accordingly. Identifying all of the CONOPS concepts and the rationale for including them in the projected architecture of the ACC is essential in creating an environment that is clear to and followed by all ACC personnel.

4.7.8 Proposed ACC Operational Architecture

In this section, the ACC Operational Architecture is clearly outlined in a graphical representation. The architecture depicts of the information flows, systems, inputs, and outputs. A common way to illustrate this process is to create an organizational chart, asset diagram, or hierarchy chart that will show how information will be received by the ACC and then disseminated throughout the airport and beyond to external organizations.

4.7.9 Organizational and Business Impact

Incorporating a new ACC into an existing airport management's structure will likely result in the modification of numerous functional interactions and physical interfaces outside of the ACC. Numerous policies and procedures are likely to change to reflect the new communication flows. All airport stakeholders will be interested in how the new ACC will change their jobs, roles, and responsibilities. Management's statement on how the new ACC will affect the rest of the organization is critical in assimilating the new structure into the existing airport organization.

4.7.10 Risks and Technology Readiness Assessment

Creating a risk assessment that reflects the potential risk to the ongoing operation of the ACC ss essential in developing a CONOPS. Different from the project risk assessment, this assessment looks at the threats to ACC operations and focuses on how those threats can be eliminated or mitigated.

Threats to managing the ACC must be considered as expansively as possible. Further, the actions taken in response to the risk assessment will include measures designed to increase the ability of the ACC to respond to an event or multiple simultaneous events, as well as provide increased safety and security measures as irregular operations evolve.

Depending on the ACC, the immediate and long-term effects of an event that degrades, disables, or eliminates an ACC can be significant. Although this Guidebook is not intended to be a primer on conducting a formal risk assessment, the following guidance is offered to help an airport operator ask the proper questions as they specifically relate to an ACC.

The key elements of an ACC Threat and Vulnerability Assessment should include the following:

- Developing a clear perspective of the interrelationships between the ACC and the organization, and its systems, structures, business, information/data, and people.
- Identifying threats and vulnerabilities and the risks associated with each.
- Quantifying the probabilities associated with each of the identified risks. To the greatest extent possible, the probabilities should be based on factual data. Probabilities of risk can be gathered based on past airport experiences.
- A review of the personnel necessary to resource the ACC during regular operations, irregular operations and emergencies.

Although identifying risk is a crucial step, it is meaningless without taking steps to mitigate the most likely risks identified. Typically, addressing risks for an ACC project will result in one of three outcomes. The risk is "avoided" by taking alternative steps than originally considered, thereby eliminating the risk totally. For example, an identified risk concerns the location of the ACC in a particular building that does not meet certain earthquake standards. Rather, than dealing with the risk directly, the airport operator chooses to avoid the risk in its entirety by moving the ACC to a building that is compliant with local earthquake codes.

Risk can also be "accepted." A projected risk may be too small or too large to mitigate and also cannot be avoided. In this case, the airport management team accepts whatever probability and effect may come. Although this is not a desirable resolution, it occurs in extreme circumstances.

The third response—"mitigation"—is the most likely. The project team and, where the situation is integral to the success of the project, airport management, look at each identified risk and determine the best manner to (1) reduce the likelihood the risk will occur and (2) devise a response to the risk to lessen its effect, should it occur. The reduction effort and the response must be clearly documented, with a detailed description of the necessary steps to be taken and the responsibility of the airport personnel assigned to carry out the actions.

Risk management and mitigation is a continual exercise as new risks are identified and new mitigation efforts required.

4.8 Situational Awareness

Situational Awareness is the perception of events and activities in real or near-real time, seen by an individual or group, and their understanding of how those events and activities may be related. More simply stated, it is knowing what is going on from moment to moment so the ACC operator can react, if and when required. Situational Awareness is the first step toward the understanding and mastery of an event or situation.

There are three levels of situational awareness:

- **Level 1—Perception.** Being able to perceive your environment. This is achieved in many ways in modern command and control environments, including field communications, sensors and alarms, video surveillance, and direct observation.
- **Level 2—Comprehension.** Understanding how the perceived information relates to the incident or threat as well as to other information. This can be extremely challenging in today's command and control environment, with potentially thousands of individual data points reporting simultaneously in multiple systems.
- **Level 3—Projection.** Being able to project from current information and events to anticipate future events and their implications.

The level of situational awareness attained by the ACC staff depends on the inclusion of functions in the ACC. The more the ACC is responsible for controlling a situation or providing critical direction to others, the more likely it is to have direct receipt of operational intelligence and, subsequently, to operate effectively itself.

For example, in a facility that is strictly a communication hub responsible for passing and sharing information from one party to another (rather than collecting the data and acting on it), situational awareness is less available and less critical to the ACC personnel, given that their primary role is communication for others to make decisions for action.

In contrast, where ACC staff have more command and control responsibility, such staff will require more information to make critical decisions and provide direction to others accordingly. In this case, situational awareness is essential for the ACC staff to understand the conditions and act on them appropriately.

4.8.1 Delivery of Situational Awareness

Situational awareness can be developed in different ways:

- Direct observation of an event or situation.
- Observation reported by third parties.
- Observation through CCTV systems.

- Observation through sensing systems (e.g., fire alarms and security alarms).
- Observation related by news and media outlets.

Technology-based systems are an excellent means to enhance situational awareness by extending the depth and breadth of information available to the ACC operator. CCTV and remote-sensing systems, in conjunction with properly configured access to live radio and telephone links, multiply the data sources available for enhanced situational awareness.

However, there can be too much information, particularly if much of it is irrelevant or distracting from a critical event. This can be detrimental to effective decision-making by overwhelming the ACC operator's ability to process it. There is significant evidence that shows an excess of information can place such a high demand on a human operator or responder that they cannot absorb or process it all and may miss or misinterpret critical points.

This is not to suggest that available information should be limited. An ACC should have access to information where it is appropriate and useful to decision-making. Several approaches can be taken to avoid overloading the ACC without losing vital information:

- Disperse blocks of information to different people or teams, who filter critical data to a manager or team charged with decision-making.
- Establish levels of criticality for information or alarm conditions, so that more urgent concerns are elevated for attention sooner.
- Provide a smaller number of points to focus on, while allowing different information streams to be viewed. An example is a video wall with a limited number of screens but a high number of video feeds, allowing the ACC operator to select and change their primary views as the situation develops.

4.8.2 Situational Assessment

Situational awareness is knowing what is going on around you and what to do about it. Useful and relevant situational awareness demands a thorough level of knowledge of normal activity and a similar level of information flow about what is happening currently—sometimes in more than one area. This requires the operator to have the tools, skills, and capabilities to understand the differences among the events, along with the available options and consequences for each response.

Situational assessment is dependent both on the quality of information and the capacity for the ACC staff to process that information and make decisions appropriately, including adapting or changing direction based on how an event unfolds from moment to moment.

Key considerations and elements of effective situational awareness include

- Good quality information delivered in a timely manner.
- Where situational awareness drives organizational response to an event or activity, reliable bidirectional communications.
- Flexibility to allow for changing conditions.
- The information sources that need to be delivered. (These are driven by the level of situational awareness required of an ACC staff.)

4.8.3 Situational Awareness Templates

To provide a structured approach to situational awareness, the airport operator should create a situational awareness template (see Appendix D) that outlines specific airport scenarios that may occur and identifies information inputs, metrics for identifying severity, and an approved response to each situation. For example, if the ACC manages airport automobile traffic and that traffic regularly causes conditions that require management action, a situational awareness outline can be developed listing the information suggested above. An airport operator can go one step further and identify situations that require regular review and establish a routine for inspecting, reviewing, or monitoring the situation. Using an automated situational awareness management tool, an airport operator could permanently record each review, the results, and any actions taken. The situational awareness template is a critical component of an ACC, if the ACC is used as a management arm in addition to being an information conduit.

SECTION 5

Communications Center Design Concepts

Simple ACCs have a history dating back to the early part of the 20th century when airports started to become common throughout the world. During the early days of aviation, technology tools were relatively few—most airports' communication technology toolkit consisted only of radios and telephones and airport staff typically had direct visual contact with passengers, aircraft, and airport facilities. As electronic security and operational systems were adopted, airport security and operations staff migrated to a simplified version of what we now call an ACC, and operators were increasingly removed from direct visual contact with the operational environment. Although new technology tools provided greater functionality, they also removed the intuitive nature of direct observation and replaced it with information provided through electronic systems. Rather than being able to see actual conditions, staff was now required to visualize conditions through the "lens" of the systems they operated.

Today's ACC is technologically different from its predecessor—Operators have access to various technologies via computer interface, large-format video displays are common, and bulky consoles have been replaced by thinner, more streamlined consoles and electronic devices. More information is exchanged rapidly via electronic means, and multiple sites are connected electronically. Although these new technologies provide more capabilities, the increases in number of systems, size and complexity of today's airports, and pace of technology evolution all challenge ACC staff to expand their grasp of information absorption and situational awareness.

The ACC Design Phase translates the goals expressed in the CONOPS as defined by user requirements and subsequently refined in the planning documents into an organizational architecture composed of processes, procedures, functions, hardware, software, infrastructure, and facilities.

Effective ACC design requires a balance of form and function. For an ACC, function tends to dominate—defining everything from the supporting spaces and infrastructure to the requirements of the engineered systems (e.g., mechanical, electrical, and fire protection). Depending on the functionality, ACCs may have the same needs as major data centers in regard to reliability and redundancy of heating, cooling, and power.

The physical form of the ACC is almost as important as the activity being carried out. As with most specialized facilities, characteristics unique to the space must be accounted for in the design. Such characteristics include issues such as sightlines and lighting and a comfortable physical environment designed to support collaboration without distractions in the workspace.

5.1 A User-Centric Approach to Human Factors (HF) Design

To ensure that human factors are sufficiently addressed in ACC design and operation, it is helpful to consider the perspective of the users in terms of the following four key elements of the user experience:

- **Access to Information.** All users in the ACC need access to a wide array of information to perform their jobs. The source and types of information may vary widely, depending on the person's role in the ACC, but such access is always necessary. Information may come from various sources (including both fixed and portable technology systems, individual or corporate stakeholders, news feeds, government entities, and personal observations) and can be delivered via visual displays, audio, paper, or interpersonal communication.
- **Technology Tools.** The various technology tools in use each have HF aspects that significantly affect user efficiency and effectiveness.
- **Interpersonal Collaboration.** People must be able to interact effectively with one another within the ACC to achieve results. Many factors—technologies, space layout, organizational structures, personalities, and organizational cultures—affect interpersonal collaboration.
- **The Physical Environment.** The space layout, environmental aspects (e.g., heating, cooling, lighting, and noise control), consoles, seats and furniture, and other physical characteristics all significantly affect users.

These four elements relate to three zones:

- **The user's immediate environment**: This includes the equipment the user is operating, desks or consoles, seating, and people next to them. This zone has the greatest effect on the user and requires significant effort to ensure that it is conducive to a positive user experience.
- **Within the ACC**: The next zone is the ACC environment just outside the immediate zone and includes the rest of the ACC environment. Although the user may not inhabit or interact with the rest of the ACC as much as their immediate zone, the user is affected by the space layout, location of staff, placement of large video displays, and other aspects of the overall ACC design.
- **Remote**: Although not in the ACC, the user interacts with people, technology, information, and physical spaces in remote locations.

Success in the design phase is dependent on engaging an architectural and engineering team that is aware of the functional issues and requirements of the space and capable of driving a design that supports these without sacrificing architectural amenities or good, comfortable space design. Further information on Facility Space Requirements and Layouts (Section 5.6), Ergonomics and Equipment, such as acoustics and lighting (Section 5.7), and incorporating Human Design Factors (Section 5.8) is presented below.

5.2 Human Factors Challenges in Information Absorption

Although there has been significant technological innovation in recent decades, much of the human activity in ACCs today remains focused on tasks that have not fundamentally changed since the 1960s:

- Operation of equipment at consoles or desks.
- Telephone operation.
- Interpersonal contact between individuals at their working posts, in meetings, and so forth.
- Operation of video management systems and use of large-format visual displays.

- Printing, distribution, management, and storage of paper.
- Maintaining normal operations during unusual events.

Nevertheless, the challenges to information absorption and situational awareness caused by these activities have increased significantly as the number of systems that achieve these tasks has increased substantially and the speed with which they deliver information has grown proportionally greater. Factors that contribute to human fatigue and reduced performance include the following:

- **Equipment.** The quality and performance of the equipment the operator uses significantly affect information absorption and situational awareness. For example, if electronic systems are poorly designed and difficult to use, or perform sluggishly, information absorption and situational awareness will suffer. Poor-quality computer monitors may prevent operators from fully comprehending information and can cause eye strain.
- **Access to Information.** For operators to perform at peak efficiency, they need appropriate information delivered in a timely fashion. Information starts the operators' workflow; when high-quality information is not available, information absorption and situational awareness suffer.
- **People.** Operators need to interact with other staff in the ACC as well as with technology systems. If interaction is difficult because of poor space layout, inadequate electronic communications, or other data sharing factors, information absorption and situational awareness will suffer.
- **Environment.** The ACC needs to be designed to be conducive to ACC activities and staff. Strict control of temperature, lighting, noise interference, and other factors can produce an environment that fosters effective information absorption and situational awareness.
- **Stress.** The high-stress nature of the ACC environment, which includes critical situations requiring fast and effective action, can cause mental fatigue, thereby lowering information absorption and situational awareness. Long hours working at consoles can stress the human body, thus lowering information absorption and situational awareness.

As technology continues to rapidly evolve, remember that technology is only a tool and people should remain the primary focus of the design and operation of ACCs. Application of an HF approach to communication and command and control center planning and design helps ensure the operator remains the primary focus. This user-centric focus on the requirements of the operator should result in greater operational efficiency and effectiveness.

Human factors orientation requires a multi-dimensional approach to integrating people, processes, and technology. All aspects of the physical and logical environment need to be considered. Moreover, the introduction of new technologies should be iterative, simultaneously aligning with and influencing people and processes. As people and processes interact with new technology, work capacity and efficiency should increase, thus allowing for changes in process and staffing, and ultimately laying the basis for the introduction of new technology as the cycle repeats itself.

5.3 Location and Physical Components of an ACC

The last of the six "who", "what", "why" . . . questions is "where" and it is answered in the design phase. The answer to the "where" question depends on whether the ACC going to be a newly constructed facility or incorporated into an existing structure. Answering this question becomes more complex when the special considerations of an ACC are contemplated, such as

- The relationship to the airport's technology infrastructure—both primary and redundant.
- The need/desirability to have access to the airfield.

- For locations with the potential for natural disasters (e.g., earthquakes or hurricanes), its ability to withstand those natural events.
- Clean and uninterrupted power, with acceptable backup power.
- Suitability of space (e.g., size, Americans with Disabilities Act [ADA] requirements, and environmental considerations).
- Funding availability.

The proposed location should also be discussed in terms of longevity. For example, an interim facility may be desirable while the airport plans for a permanent location. When determining the location, the following factors should be considered:

- Geographic location is extremely important. Assess the geographical threat profile using data from FEMA and other sources to evaluate the possibility of threats (e.g., flooding and storms). An ACC facility should not be next to inherently risky areas (e.g., loading docks or parking structures).
- Locating the ACC facility within a terminal or other building with public access can significantly impair survivability, cost, and usability. If possible, locate the ACC where it has the most physical protection from threats. In a basement or ground floor, the facility may be subject to flooding, while the highest floor of a building could be affected by storms or high winds. Avoid exterior walls and windows because of projectiles or explosions. If an exterior wall or window cannot be avoided, use wall-reinforcing techniques or window blast curtains.
- An ACC facility will require a data center and/or a network operations center (NOC) that provide large-capacity utilities (e.g., power and cooling). Although the data center need not be immediately next to the ACC facility, greater distance creates greater costs for network and cabling connectivity and greater possibility of disruption.
- Consider co-locating multiple ACC facility elements to leverage infrastructure and reduce overall cost. Having an EOC next to an AOC/SOC can provide definite advantages during emergencies.
  - Choose a site that has easy access during emergencies. Consider the difficulty of gaining access to ACCs inside the airport when the perimeter becomes locked down during emergencies. Those needing access may include first responders, outside staff, and parking and logistical space staff.
  - Plan for logistical support. During emergencies, it is common for staff to occupy the Command and Control Facility for long periods of time. This may require food and water supplies and added computer or communications equipment. Ensure there is adequate power; IT bandwidth; space; access for deliveries and people; and, possibly, cooking, sleeping, and bathing facilities.
- Ensuring survivability of systems in the event of system crashes, extreme weather, accident, or deliberate attack requires a structured approach to ensure the appropriate balance between robustness and cost control. To find the best balance, perform threat assessments (both physical and cyber) to determine the threat landscape and likely threats.
- An additional consideration is the location of a backup facility, should the primary ACC experience a catastrophic failure that renders it unavailable. Section 8.8 discusses considerations in developing a backup ACC.

Examples of threats that may be encountered include the following:

- Regional threats—weather, earthquakes, floods, population unrest, and other factors unique to the area where the ACC is located. Mitigation strategies include site selection to minimize threat exposure, facility hardening, and use of intelligence services and cooperation with local law enforcement to stay informed of emerging threats.

- Site threats—local utility grid reliability, nearby dangers (such as chemical plants and flammable materials next to the ACC).
- Facility threats—structural integrity, perimeter security, and equipment reliability.

The facility in which the ACC resides is an important part of survivability and deserves significant attention early in the design process. The ideal scenario is a robust structure capable of withstanding severe weather and some level of blast resistance. However, financial realities typically dictate that the ACC will be within an existing airport structure that may not have been designed with robust survivability in mind.

When locating the ACC within an existing structure, be careful of threats imposed by the structure itself. For example, although basement space may be readily available and economical, it poses risks of flooding. Locations next to windows or on the top floor of a structure are subject to risks from storms or blast.

The infrastructure of an ACC facility, although similar to those of commercial buildings, diverges significantly in a design process that determines adequate physical capacities, operational capabilities, and other attributes.

Basic physical components of an ACC are

- The **electrical infrastructure** should have adequate capacity and conditioned backup power. Space for a generator should be allocated outside the facility, while space for an Uninterruptible Power Supply (UPS) and electrical switchgear should be allocated inside the facility. If possible, use a dual-fuel generator to provide greater alternatives for fuel sources during emergencies. When sizing the generator, the general rules used in normal commercial facilities (where the generator is usually sized only for the minimum capacity to facilitate evacuation of the building) do not apply to ACC facilities. Plan for extended operation using only generator power, and size the generator to support all the key systems that will be required (including HVAC and servers). The ACC should be able to operate even when local utilities are non-existent.
- **Heating, ventilation, and air conditioning** (HVAC) will be one of the key needs for the ACC due to the number of electronic components contained within. Because HVAC is one of the costliest elements to retrofit after construction is completed, it is better to slightly overdesign (to accommodate future expansion) than to underdesign and lose that flexibility. Further, consider systems that provide positive air pressure if smoke or other air contamination may be an issue.
- **Structural** attributes such as blast protection, high wind resistance, or earthquake criteria should be considered when designing new structures. When retrofitting existing structures, blast netting and other accommodations should be used.
- **Network/Internet access** should be available from multiple sources to provide redundancy. Check with telephone carriers about the availability of dual, spatially separated feeds to the facility. Check with Internet Service Providers to secure connections from multiple sources, including possible satellite connectivity as a backup.
- **Envelope electromagnetic/lightning protection** should be part of the design, and shielding from electromagnetic pulse (EMP) may be warranted in certain cases.
- **Wireless signal penetration** is often an issue. Depending on the location, it may be desirable to enhance penetration of wireless signals from outside when they are part of your communications network or to block them when signal interference is an issue. Wireless signals from cell phones, public safety radio systems, GPS, satellite, and other wireless communications should all be considered. To block wireless signals to prevent unauthorized communications, the use of a "Faraday Cage" technique is effective. By enclosing an area in a wire mesh, it is possible to block wireless signals. Wall coverings, ceiling tiles, and other building materials

with inherent wireless shielding are available. To enhance wireless reception inside the facility, wireless repeaters may be necessary when the building's structure blocks signals. Multi-band repeaters that will work with all the wireless devices used should be considered.

- **Resupply and storage space** for essential supplies, such as food, fuel for a generator, batteries, and office supplies, should be considered in the design.
- **Satellite dishes** will require space on the roof and line-of-sight access to satellites. They will also need periodic maintenance. Plan roof layouts and access accordingly.

5.4 Basis of Design (BoD)

The Project Management Plan explains the ideas, concepts, and criteria important to airport management and expressed in the project charter. The Basis of Design (BoD) documentation explains the processes and assumptions behind design decisions that are made to meet the design intent. The design intent evolves from more general descriptors to more specific descriptors during actual design, to in-depth and specific descriptors during the specifying stage. These last are finalized during the as-built phase. Under each area or building system is an outline of the building construction and operational requirements to meet the needs of the owner and the building occupants.

The BoD document is a compilation of the specific criteria, codes, standards, guidelines, and specific project data and calculations that are the basic information that meets the owner's requirements. This information is used to develop the design and construction documents. The BoD establishes the technical and facility requirements necessary to meet the CONOPS goals.

The BoD is not a design itself, but a way for airport management and the ACC architect to define the parameters of the design by examining alternate ways of meeting functional requirements. Each option is described in sufficient detail, including its advantages and disadvantages, along with estimated costs.

A typical BoD document will include the following elements:

- General facility description, including backup.
- Facility location or a set of possible locations.
- Space requirements and descriptions.
- Adjacencies.
- Regulatory and code requirements.
- Requirements for redundancy, reliability, and recovery.
- High-level descriptions of engineered systems (e.g., mechanical, electrical, and fire protection).
- High-level descriptions of technology-based systems.

Typically, the BoD will not describe operations and policies or procedures, although it will be influenced by these requirements.

When the BoD has been completed, the design team will have a documented baseline of expectations and requirements from which to develop, design, and refine the facility and its supporting elements so as to produce documents suitable for construction.

The BoD and the CONOPS must be synchronized to ensure that the functionality envisioned for the ACC in the CONOPS is reflected in the design documents. This synchronization is best achieved by the project manager of the ACC project and involves collaboration between the various entities participating on the project team throughout the design and construction effort. Although the CONOPS should be the guiding document, design constraints may affect the CONOPS. In these cases, the project manager must elevate the issue to airport management, who must be included in decisions mitigating the effect or in revising the CONOPS.

5.5 Functional Design Objectives

The design process should address the following performance and functional objectives and detail how such objectives are to be provided and validated:

- **Scalability.** Scalability is a measure of the ease with which a facility, system, or elements of a system can be modified in size and capability to meet changing performance requirements. For an ACC, scalability means increasing the size of the facility as needs grow or expanding technology systems to support additional needs.
- **Reliability.** Reliability refers to the ACC's ability to continue to operate without a failure that compromises the integrity of the overall facility. Reliability is generally expressed as Mean-Time-Between-Failure (MTBF), which depends on equipment design and manufacturing processes.
- **Maintainability.** Maintainability refers to the ACC's ability to undergo normal preventive maintenance and corrective maintenance without the integrity of the overall system being compromised. Maintainability is generally expressed as Mean-Time-To-Repair, which is derived from equipment design and manufacturing processes.
- **Availability.** Availability refers to the ACC's ability to operate and perform normal functions, such as updates, backups, and recoveries, without compromising the integrity of the system. Availability extends Reliability and Maintainability to include equipment operation and duty cycle in the airport environment and the effects of operator training, support policies and programs (including servicing and spare parts replacement), and other factors that may not be intrinsic to equipment designed and manufacture, but affecting equipment performance. Availability also considers the redundancy of key systems, such as mechanical (cooling and heating), power (using normal/utility and emergency power sources), and networks and communications infrastructure.

5.6 Establishing the Design Process

In planning facilities, recognizing the symbiotic relationship between design and construction is important. Design and construction processes are best viewed as an integrated system. Broadly speaking, design is creating the description of the ACC, usually represented by detailed plans and specifications, while construction planning is a process of identifying the activities and resources required to make the design a physical reality. Hence, construction is the implementation of a design envisioned by architects and engineers. In both design and construction, many interdependent tasks must be performed.

In planning newly constructed ACCs, the following should be kept in mind from the beginning of the project:

- Nearly every ACC is custom designed and constructed and needs an appropriate amount of time to complete.
- Both the design and construction of a facility must satisfy the conditions peculiar to a specific site.
- Because each project is site specific, its development is influenced by natural, logistical, and other locational conditions (e.g., access to the airfield and relationship to network and data center resources).
- Given the long service life of an ACC, future requirements must be anticipated.
- Because of technological complexity and new functions being added as the ACC concept evolves, changes of design plans during construction are not uncommon.

5.6.1 General Design Considerations

In most ACC development processes, it may be necessary to use the services of a qualified design team composed of architects, engineers, and specialty consultants (possibly including audio/video designers, acoustical engineers, and lighting designers). Although many larger airports have internal resources with experience in some of these areas, few have extensive experience designing these complete facilities. The components and requirements of ACCs are sufficiently complex and unique that specific expertise is essential.

This is not to say that internal staff should not be engaged—architectural, engineering, and other design and operational professionals within the airport organization are the critical source of user requirements to the CONOPS and have the locally specific experience to offer significant support and historical perspective to the process. These individuals need to be involved from the early stages, as stakeholders, participants, and active contributors.

In airports with existing ACCs (or similar centers), developing a new facility may result in outages and communication disruptions due to construction and cutover activities. Because many of the existing facilities support public safety operations, interruptions in service due to contractor activities must be prevented. During construction, all existing radio communications systems, telephone systems, and computer systems should remain fully operational during the installation of the new system and until acceptance of the system by airport management. Where interruptions in service are deemed necessary, coordination and communication among the parties is essential, and planning for alternate means of maintaining service must be developed.

Finally, developing a new ACC does not happen in isolation. The new facility may be developed over a multi-year period, often within a new or existing facility upgrade; therefore, it must integrate with existing or upgraded infrastructure. Coordination with other airport projects to avoid conflicts or unnecessary duplication of effort is essential and can prevent or mitigate issues such as inadequate power, conflicts for contractor access or logistical spaces, and integration issues due to network or other airport technology systems.

5.6.2 Using 3-D Modeling in ACC Design

The use of 3-D modeling is invaluable in visualizing the finished ACC before construction begins. Although floor plans are sufficient to understand space layouts, they cannot convey the full experience of being "inside" a 3-D virtual model. Being able to "walk" through the space, "sit" in the seats, and see exactly what people will see inside the ACC is extremely valuable.

3-D modeling can also show design flaws not visible in floor plans. In one recent example, a large emergency management agency facility's large-format video displays were originally designed to be mounted on the 40-ft-high walls of a huge room. A review of the design using a 3-D digital model of the space examined the sightlines and allowed "inhabiting" the virtual model and "sitting" in the virtual seats, which revealed that the placement on the walls was far too high to be usable. Catching this mistake before construction saved the client several hundred thousand dollars and prevented major time delays.

5.6.3 A Holistic Design Approach

Technology is so interwoven in the fabric of the ACC that the design team should integrate architectural, engineering, human factors, and technology design into a single team. Although it is normally assumed that the design team will include architectural and engineering professionals, the modern ACC is so complex that it warrants the involvement of additional professionals such as technology and human factors/ergonomics design specialists.

The technology and human factors/ergonomics designers should be involved from the beginning of the design process. Technology can affect architectural and engineering design significantly, sometimes in ways that only the technology designer can anticipate. Mistakes (e.g., undersizing technology spaces or HVAC capacity or putting consoles or video walls in the wrong places) can be costly to change later. Likewise, a human factors/ergonomics designer can influence the design in ways that may not be readily apparent to the other designers. Investing a small amount in these professionals initially will pay significant dividends in the end.

5.6.4 Accessibility as a Design Factor

In addition to typical human factors concerns, the ACC must comply with the ADA and possibly other regulatory requirements, depending on individual staff members' needs. Given that accessibility is a complex consideration, this Guidebook does not address details; however, ACC designers and managers should verify that basic ADA requirements are met and should determine if any staff require special accommodations due to disabilities. Some needs (such as those resulting from wheelchairs, braces, or crutches) are obvious, but not all disabilities are discernible. Human resources professionals should be involved so as to determine which staff have special needs. Challenges such as color blindness or hearing impairment may require special approaches above and beyond satisfying basic ADA requirements. For example, when there is a visual or hearing impairment, Section 508-compliant software can accommodate many needs (see http://www.section508.gov for more information). Keep visual and hearing impairments in mind when designing ACC equipment for communicating with the ACC staff (e.g., signage or video displays). For example, when color coding is used, add symbols to accommodate staff who are color blind.

5.7 Facility Space Requirements and Layouts

In the optimum layout, system users should be arranged so that there is a balance of collaboration and face-to-face communication, as well as a degree of privacy, isolation, and acoustic separation in performing activities. During day-to-day operations, certain events and the response to these events will call for console operators to consult with one another—this should be possible by turning in one's seat to discuss a situation with an adjacent console operator.

Space planning will need to address situations from accommodating immovable architectural obstructions to a free arrangement and ideal positioning of consoles, furniture, support hardware, and displays. The ceiling height and the beams in the ceiling directly affect how the space will be used, how the line of sight to shared displays will be accomplished, and how sounds will be perceived. It may be feasible to array consoles in an arc or circle, a cluster, or in a linear row-by-row fashion, providing adjacency for related functions.

The following spaces typically are provided for airport ACCs:

- Communication and dispatching operations areas.
- EOC.
- Break room/lounge area (with coffee machine, sink, microwave, dishwasher, and related facilities).
- Kitchen and dining room.
- Locker rooms.
- Supervisor/management offices (to include computer access, telephones, radios, and faxes).
- Storage rooms.
- Space for bookshelves, file cabinets, printers, and fax machines.

- Conference rooms.
- Server/Network Operation Center (NOC).

Certain work groups benefit from an arrangement where everyone is facing a common central node or perhaps a center supervisor console. Other arrangements seek to reduce, as much as possible, the interaction with other console operators. In a public safety dispatch environment, a design that encourages interaction between dispatchers is usually preferred—The face-to-face collaboration between the dispatchers during peak periods or major incidents can be an invaluable benefit of proper console arrangement.

The overall look and feel of the space should be designed to be soft and subdued, using neutral colors and hues. Neutral tones allow displayed video and graphics to portray skin tones and other hues more accurately than if bright colors are anywhere near the field of view. Lighting should be subdued to reduce eyestrain during prolonged operations. Chairs are critical to users' comfort, and the best possible ergonomically correct seating should be adopted for consoles. Absorptive materials on walls and in ceilings soften the acoustical environment and reduce stress and reverberation because they reduce noise bounced off hard surfaces and help to isolate the voice of a speaker within the console area.

5.7.1 Console Layout

Console positioning significantly affects many aspects of ACC operation and user experience. Rather than using classroom-style rows, many airports use console configurations that support work groups—for example, small, communal tables are placed next to work groups to provide "mini-conference rooms," thereby allowing collaboration without leaving the ACC.

5.7.2 Staff Grouping

Assessing how people interact with one other and the layout of the space are important for optimal interpersonal efficiency. Grouping staff by functional area promotes efficiency, allowing staff who need to work together to collaborate without excessive movement or disrupting other staff. It may be necessary to separate some groups from one another to reduce noise transmission. For example, staff working in an EOC during an emergency may generate considerable noise, which would disturb operators answering 911 calls or maintaining normal operations. Glass partitions separate while maintaining visual connectivity among groups and among video displays.

5.7.3 Sightlines

Ensure that staff have access to the visual resources they require (e.g., video walls and other large-format visual displays). Ensure that managers have unobstructed sightlines to staff they need to communicate with (a gesture or facial expression can be extremely valuable in communicating during an emergency). At a minimum, perform sightline studies and conventional renderings, and, if possible, use 3-D digital models.

5.7.4 Adjacent Conference Areas and Executive Spaces

Spaces next to the ACC, but not inside it, allow executive meetings without disturbing ACC operations. Some airports locate these spaces next to the ACC with a window or sliding glass door between the spaces. This allows a visual connection between the spaces, making better use of large-format video displays and allowing non-verbal visual communication. To ensure that occupants of these spaces can communicate with the rest of the ACC when necessary, audio intercoms should provide connectivity to the ACC operators as well as any other nearby spaces.

5.7.5 Support Spaces

Restrooms, locker rooms, and break rooms must be adequately sized and close enough to limit walking time spent between the ACC and support spaces. Support spaces must also provide “sensory buffers” from ACC activity, so that workers can de-stress in quiet, restful environments. Some forward-thinking ACCs install reclining chairs so that staff can relax during breaks.

5.7.6 Positioning of Shared Equipment

Printers, scanners, fax machines, and other shared equipment should be placed so as to minimize walking time from the ACC. Some ACCs locate printers inside the ACC next to workers; however, printers create noise and produce environmental contaminants (e.g., toner fumes and paper dust that can cause worker discomfort and sometimes trigger allergic reactions).

5.8 Ergonomics and Equipment

ACC consoles should enable calltakers and dispatchers to work quietly and efficiently, using ergonomic interfaces. Storage space for reference material should be provided at each console position. Consoles should support all voice and data functions of the ACC without distracting interference. Personnel should be able to stand or sit and to adjust the lighting on their consoles. See Section 5.7.1, Lighting, for detailed information.

ACC console position configuration will depend on several factors, including the focus of the facility (e.g., general communications versus security operations or emergency dispatch) and the operational philosophy of the facility as well as, to some degree, the flexibility to accommodate individual operators (e.g., disabled or physically large or small). Although some positions may serve only one specific purpose or handle multiple ACC roles, most will rotate among persons with unique physical characteristics. This variability in demand can drive the size and fit-out of consoles and furniture, as well as the scale of the technology procurement and build and the balance between operational needs, cost, and support requirements.

The range of services that can be provided from a single position includes

- Interface with airport public safety radio systems (including trunked radio systems) to communicate with units in the field and police, fire, operations, maintenance, mutual aid and Enhanced 911 calls.
- Instantaneous playback of radio and telephone conversations and video incident streams.
- Voice telephony, both external and internal to the airport, provided by a commercial carrier and IP-based, networked voice telephony.
- Access to a dynamic mapping/location system integrated with the access control and video surveillance systems, with the ability to monitor incidents in real time.
- Access to audio for the TV monitors via non-priority audio channels in the dispatchers headsets.
- CAD capability.
- Networked displays on operator workstations and video walls, if used.
- Internet access for personnel via a separate standalone computer and separate network.
- Monitoring and control of fire alarms.
- Control of vehicle and personnel access gates.
- Passenger screening entry and duress alarms.
- Access to parking garage intercom.
- Access to airport shuttle bus intercom.
- FAA crash phones.
- Individual workstation controls for task lighting, climate, and console positioning.

General office equipment and furniture in an ACC should include copiers, printers, facsimile equipment, bookshelves, work tables, and storage cabinets. Multiple handheld radio and cellular phone-charging stations should be provided in quantities appropriate to support multiple shifts of operators and observers.

5.8.1 Lighting

Lighting is critical in creating an environment conducive to information absorption and situational awareness. Lighting that is too bright or causes glare can seriously reduce information absorption and situational awareness and must be avoided. Overall lighting levels should be lower than in a normal office environment so as to enhance viewing of display screens.

Typically, staff like windows, but windows can introduce lighting extremes that make controlling light levels in the ACC difficult. When windows are present, the use of window tint film and/or operable shades/blinds will allow adjustment to avoid lighting anomalies during daylight hours.

Overhead lighting should be arranged so that it does not create glare on displays or glare directly visible by staff. When 2×4 florescent lights are used, use glare-reduction baffles; when using track lighting, be sure that fixtures are set deeply enough to hide the bulb from the direct sight of staff.

Individual task lighting is also important, especially when overall lighting levels are low. Desk-mounted task light can be useful for reading or accessing items in drawers.

Colored lighting schemes can be useful to alert ACC staff to unusual or elevated security conditions. Multiple-color fixtures placed where all staff can see them can be an inexpensive approach. More advanced systems allow lighting throughout the ACC to be altered from a single control position. Even more advanced systems can control lighting so that certain alarms/alerts trigger changes in lighting.

5.8.2 Acoustics

Sound control is important to maintaining information absorption and situational awareness, especially in high-stress environments like ACCs that also experience emergency situations. It is vitally important to control sound transmission in ACCs to prevent creation of an "echo chamber" that can quickly elevate sound levels so that staff have difficulty communicating. Sound absorption techniques commonly used include sound-absorbing materials for walls, floors, and furniture, as well as limits in the use of hard surfaces like glass and tile.

When sound issues are extreme or where it is not practical to replace wall, flooring, and furniture materials, electronic noise cancellation can significantly reduce extraneous noise. Basic electronic noise cancellation systems typically use speakers that generate "white noise," which muffles noise. More advanced systems use active damping techniques and equipment to detect noise, analyze its waveform, and then electronically generate an "anti-noise" waveform that is the acoustic opposite of the noise. The two sounds cancel each other, thereby reducing noise.

5.8.3 Workstation Design and Seating

Seating in ACCs is one of the most important and often overlooked aspects of human factors in ACCs. Quality seating minimizes stress and strain on ACC operators and enhances attention, information absorption, and situational awareness. The Human Factors and Ergonomics Society ANSI/HFES 100-2007 recommends that seating conform to the following:

- Has a lumbar support
- Has a backrest that reclines

- Has a seat pan that adjusts for height and tilt
- Supports at least one other seated reference posture in addition to the upright sitting posture
- Provides support to the user's back and thighs in the chosen reference postures
- Can be adjusted to provide clearance under the work surface
- Includes information for the user about the recommended use and adjustment of the chair

One of the most innovative developments in console design is the ability to raise and lower the desktop, allowing operators to stand or sit as they want. Although it may seem counterintuitive, staying seated for long periods is actually more stressful, both mentally and physically, than alternating between standing and sitting.

The size and shape of the console is dependent on the activity of the staff member occupying the console and the size and shape of available space.

PSAP/911 operator consoles in an ACC often use a "boomerang" shape that mounts screens and keyboard on a central section, with "wings" to the sides that keep other non-primary equipment within easy reach.

ACC Consoles used for answering 911 calls are typically arranged without a central focal point, with attention given to avoiding distractions in the operator's sightline and to providing ample space between operators for reduced noise.

Airport EOCs often use a classroom-style orientation with a single focal point to enable staff to simultaneously view managers and visual resources (such as video walls), so that information can be quickly disseminated to the entire group at once.

5.9 Human Factors

ACCs are complex high-stress environments composed of people, technology, and the physical environment. Multiple departments, roles, and functions may operate simultaneously in the ACC (depending on its profile). Various technologies are used for management, security, and other functions. The environment itself (the physical space) is designed to facilitate efficient operation of the ACC.

Activities in the ACC may deal with life safety and national security situations, requiring the ACC and its staff to operate at peak efficiency and effectiveness. One of the key aspects required to achieve a high level of efficiency and effectiveness is maintaining an environment conducive to information absorption and situational awareness. Operators must be able to digest, analyze, and act on information from a range of sources and to synthesize situational awareness from disparate sources of information.

When designing and operating the ACC, it is important to understand the link between human factors and the ability to achieve conditions of information absorption and situational awareness. In high-stress environments like ACCs, every aspect of the environment affects the staff's efficiency and effectiveness. Even minor aspects that cause distraction, inconvenience, or inefficiency to the staff are magnified in the often life-or-death situations that occur in ACCs and can hinder operations in significant ways.

Proper ACC design enhances information absorption and situational awareness of staff; poor ACC design that does not appropriately address human factors will hinder information absorption and situational awareness. To ensure the efficient operation of the ACC and information absorption and situational awareness, it is crucial to understand and optimize the human factors of the environment.

Human factors can be defined as "the scientific discipline that studies how people interact with devices, products, and systems. It is an applied field where behavioral science, engineering, and other disciplines come together to develop the principles that help assure that devices and systems are usable by the people who are meant to use them. The field approaches design with the "user" as its focal point."

Key aspects of human factors include

- Acoustical design that establishes and maintains a calm environment.
- Lighting design at individual stations and for the entire shared space.
- Furniture comfort and efficiency, with an emphasis on ergonomic needs.
- Good sightlines for shared resources and for inter-position communications.
- ADA compliance.

Review the ACC design and configuration examples for small, medium, and large airports and choose what is best for your local situation. Small airports often integrate their ACC-SOC-AOC-EOCs into one facility operating 24/7 or set up their EOC in an adjoining room for emergencies. Small ACCs often use wired telephony supplemented by trunked radio groups and cellular telephones for routine matters and emergency notification. Medium-sized airports often fully integrate their facilities to provide surveillance, alarm monitoring, police dispatch, and emergency response with cross-trained personnel 24/7. Large airports are usually integrated, but may segregate some functions while benefitting from shared facilities and cross-trained staff. CAD, access control monitoring, extensive surveillance systems and systems such as license plate recognition are more prevalent at large airports. International airports, regardless of size, are complicated by the addition of federal customs, law enforcement and immigration functions, and requirements for specialized facilities.

Architectural approaches, such as glass walls/doors or movable walls, provide the flexibility to achieve collaboration without disruption. Interior glass walls or doors can also allow visual communications between personnel who staff ACC elements as well as enable the sharing of visual resources like video walls. Glass doors, however, can present dangerous projectiles if not appropriately isolated from blasts, so they should be built to standards for blast protection.

- Consider ergonomics and human factors: A supportive human interface for each ACC operator is critical for effective performance, especially under stressful conditions.
  - Design with staff comfort in mind to reduce stress and improve performance. Be careful of lighting design to prevent glare. ACC facilities are not typical office environments, where lighting is often too bright. An ACC facility operator will be visually focused on computer screens and large-format video displays.
  - Design to manage sound. During emergencies, ACC facilities can be noisy due to the number of people and the level of activity. Use techniques such as electronic sound masking and sound deadening materials to avoid aural overload.
  - Create effective sightlines. Provide the necessary visual resources, such as video walls and other large-format visual displays. Ensure that managers have unobstructed sightlines to communicate with staff (often, a gesture or facial expression can be a means of communication in an emergency). At a minimum, do sightline studies and conventional renderings and, if possible, use 3D digital models.
  - Design appropriate seating. Ergonomic seating can increase attention spans and reduce repetitive strain injuries. Consider alternate desk and console designs. Newer desks, consoles, and seating are designed to reduce fatigue and stress (e.g., consoles that are movable up and down allow staff to sit or stand).
- Consider traffic patterns. Ensure that staff can move within the space without causing disruption. Place resources such as copier machines where staff can easily access them without encroaching on others' work spaces.
- Design for flexibility during emergencies. The profile of the ACC facility changes during emergencies because Command and Control Facilities tend to become crowded when emergencies

occur. Flexible design elements (e.g., moving walls and sliding glass doors) allow easy reconfiguration as needed.
- Plan for media access. Ensure the press area is segregated from the rest of the facility to prevent security breaches. (See Section 2.7 on establishing a Joint Information Center.)
- Create Official Observer access. If space permits, build an observation area that enables visual and audio access to video walls and other communications. This should isolate sound from the main operational area so that observer discussions are not disruptive. Observer areas may also require escort services for visitors who are not badged for the area.

5.10 Current ACC Designs

Because communications centers are unique in their individual physical and operational environments and, thus, do not follow a single well-defined pattern, it is not possible to provide an exact list of stakeholders, their functions, or their requirements. In addition, organizations with different priorities and administrative structures may take different approaches to engaging stakeholders, thereby including or excluding some additional players.

Often, the timing may be driven by a need to meet regulatory, policy, or other procedural requirements, the nuances of which must be thoroughly understood as part of the driving force behind development. An example of this is a new or upgraded terminal expansion project that may cause a relocation of the existing communications center and/or create an opportunity to include a new facility within an unrelated capital project.

The following examples reflect the site location and/or space the organization has available and provide a basis for identifying limits or constraints that can influence the design solution or are identified early as significant barriers to achieving the facility's goals. Constraints (e.g., available space or location) can and should be raised early to identify alternatives and options if planned location(s) should become unsuitable or less than optimal (i.e., it may be more cost-effective to wait, if new capital projects are on the airport's horizon).

5.11 ACC Examples

ACCs come in all sizes and configurations—there is no single best design. The following are examples of ACC facilities in use at small and medium-sized airports. There is wide variation in functionality, design, and sizing; each ACC must be adjusted to local requirements and local budgets. Large or Category X airports have so many possible configurations that is not possible or even desirable to try and define a single example.

5.11.1 Small Airport

Figure 5-1 shows an example of a small airport. This airport has built an integrated AOC-EOC facility. The Airport Police Department (APD) is located separately, close to the TSA checkpoint for response reasons.

Next to the AOC is the EOC, a conference room equipped with a large table having both power and LAN outlets for participant laptop computers and large video screens to display activities at multiple sites. The ACC does not provide for operators to remain overnight during emergencies but has made arrangements with nearby hotels, should this become necessary.

The same spaces used for the AOC and the EOC include offices for the Manager of Airport Operations, the Security Coordinator, and the two Operations Supervisors. Their locations provide immediate access to the airfield, with equipped response vehicles parked at the exit portal.

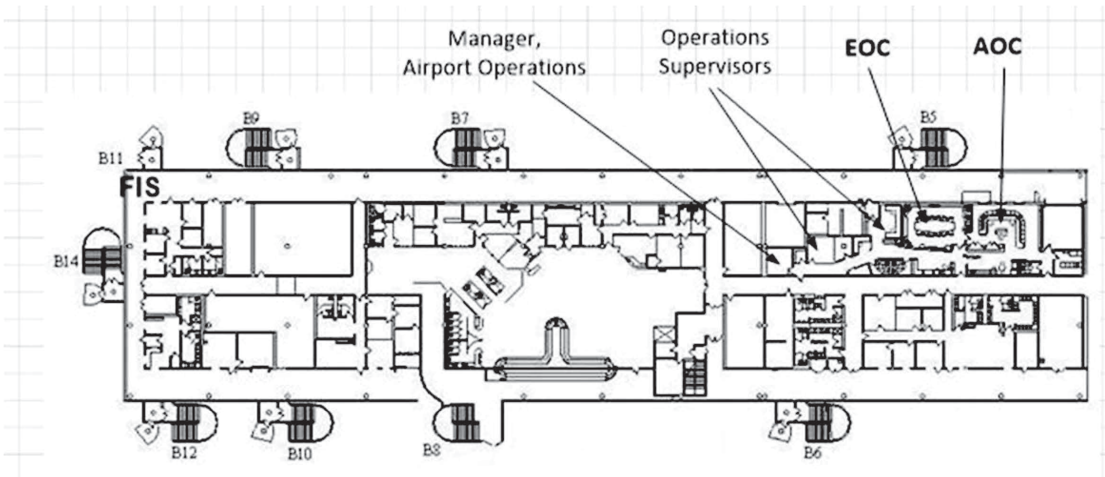

Figure 5-1. Example small airport.

Communications modes and technologies include

- Wired telephony, which is the primary means of communicating with external parties.
- Trunked radio talk groups, provided by the 800-MHz radio system of the city and used by the Operations, APD, and ARFF staff.
- Cellular telephones, used by airport management, operations, and maintenance staff for routine activities and receiving alerts, including notifications of security breaches and emergency events. The airport has two cellular carriers that use different modulation schemes. The CDMA-based carrier primarily serves the airport management staff. The GSM-based carrier primarily serves operations and maintenance, and its service includes a push-to-talk party-line type radio mode, commonly known as Direct Connect, which is popular with maintenance personnel.
- Standard VHF radios for airfield and ATC tower communications.
- The terminal building is augmented with emergency generators providing power during outages for up to 3 days.

Design criteria for data storage requirements are often driven by state law, which sometimes requires that all video imagery and voice messages recorded by a state agency be stored for a minimum of 30 days and may require a minimum level of resolution for forensic review purposes.

The airport in the above example has complex external communications because the airport property overlaps two counties and one City, so it must be able to communicate with multiple public safety (Sheriff and Police), fire, and EOC. Most such communications are done by wire telephony; the airport does not have dedicated fiber links to any external agencies. It does have priority access arrangements with its cellular carriers, but, in an areawide emergency, the airport is still vulnerable to the volume of public safety communications overloading cellular channel capacity. External communications requirements are set forth in the Airport Emergency Plan (AEP) and should be developed in the CONOPS for informing the ACC planning and design.

Lessons learned from building and operating the integrated AOC-EOC at this airport include

- Involve Operations, Police, IT, and other stakeholders early in the CONOPS and planning/design stages.
- Locate the facility in a secure area, not in a public area, to avoid distractions.
- Include break room and restroom amenities within the center to maximize staff comfort and reduce the need to leave the center.

- Co-locate Operations, Public Safety, and Security functions to the maximum extent possible.
- Enable multiple ACC monitoring stations to perform all functions, including support of area-wide emergencies.
- Locate Operations offices on a ground floor, inside the secure perimeter of the airport, with airside vehicles close by for ready access to the airfield.
- Locate IT and communications equipment with the monitoring stations, including UPS backup, with central equipment and backup provided in a different location(s).
- Cross train AOC station operators.
- In future infrastructure planning and design, provide capacity for cable pathways to areas where additional functions might have to be provisioned. If fiber cabling is installed in these pathways, cable specifications should be compatible with the pathway design, including cable bend radii.
- If a raised floor in and around the AOC is used for cabling and equipment, ensure that ample space is provided for easy installation, addition, maintenance, and replacement of power and data cabling vs. intra-wall fixed conduits.

5.11.2 Medium-Sized Airport

Figure 5-2 shows a medium-sized airport's approach. This airport has configured an integrated AOC-Police CAD-EOC, known as the AOC. It is within the APD, but this facility is scheduled to be relocated under an announced construction program. As the design work progresses, beginning with the BoD phase, opportunities will arise to prepare an AOC-specific CONOPS.

The AOC provides police dispatch, surveillance, and physical security monitoring, and emergency operations support functions, including response to physical attacks and natural disasters as set forth in the AEP. The AOC is staffed 24/7 by airport police and operations personnel. Within the AOC, the multiple stations are equally capable, and operating personnel are cross-trained for their functions to provide redundancy.

The AOC is configured with a full set of communications modalities, including wired telephony, cellular telephony, 800-MHz trunked radio talk groups provided by the local county, and a LAN capable of carrying IP telephony.

The airport uses the communications services of the County Sheriff's Office. This consists of two 800-MHz Simulcast Systems and a Microwave System that connects 15 communications sites throughout the county. The Mutual-Aid Conventional Simulcast System provides

Figure 5-2. Example medium-sized airport.

countywide radio coverage on four mutual-aid channels using seven transmit/receive sites and two receive-only sites.

Mobile and portable radios are also programmed with conventional talk-around channels used for car-to-car, portable-to-portable, and portable-to-mobile communications. Range is limited, but in an emergency, these channels could provide communications between units working an event. The Mutual-Aid Conventional (Talk-Around) Channels are programmed into every radio for interoperability between public safety agencies, including other counties and state agencies.

External communications, as set forth in the AEP are the responsibility of this airport's IT department in coordination with County Sheriff and Fire departments. The IT department provides for redundancy and backup capabilities, with servers and UPS in the equipment room next to the AOC, additional UPS backup in central IT facilities, and engine-generator cutover from UPS units.

SECTION 6

Construction and Activation Activities

As with other aspects of traditional airport business practices, this Guidebook does not go into great detail on construction and activation activities routinely performed by an airport operator. Only those few items critical to the successful implementation of an ACC will be discussed in this section.

6.1 ACC Design

Section 5 presented design considerations for the ACC. The design decisions identified will be further detailed in the plans and specifications found in the typical construction project. Having a solid base of detailed plans, specifications, and documents enable parties to communicate and ensure that appropriate designs, materials, and construction techniques are used. Airport operators should use their normal processes for creating a fully informed design package that can then be passed to the internal or external entity to any necessary construction.

Many airport operators have chosen to use the Construction Specifications Institute (CSI) MasterSpec specification process or have supplemented those standards with local factors and requirements. Regardless, developing CSI-based designs is an iterative process, with progressively detailed submittals at the 30, 60, 90, and 100% development milestones for the end user and other appropriate stakeholders to review. Two CSI specification sections (Division 27, Communications, and Division 28, Safety and Security Systems) are especially useful for specifying the design of an ACC.

The CSI process begins with the BoD report for developing detailed specifications and design drawings. The BoD serves as a bridge between the airport's operational and functional goals as established in the CONOPS and the detailed technical design necessary to meet those goals.

6.2 Construction Oversight

The airport operator probably has a construction oversight and monitoring process. Typically, the actual construction of an ACC is a sub-project of the entire ACC initiative. This is a good approach, given that construction management principles and techniques will likely not blend well with many of the special requirements of an ACC project, such as developing a CONOPS. Nevertheless, close coordination between the ACC project manager and the construction project manager is essential, and the best possible scenario is one where the construction schedule is integrated into the total project schedule and regular written progress reports are provided from the construction management team to the ACC project manager.

The ACC PM will also play an important role in coordinating the integration of the construction schedule with the implementation schedule of technology components. There can be a great deal of inter-related activity between construction and technology, especially where the new center is incorporating new or extended technology components. Section 7 outlines considerations for technology-heavy ACC projects.

6.3 Pre-Opening

During the construction or renovation process, it can be helpful to provide the projected ACC personnel with a walk-through of the future facility. This walk-through helps to familiarize personnel long before training, orientation, and opening day occur and increases their comfort level.

6.4 Periodic Construction Monitoring

In addition to the regular construction inspections that are a normal part of a construction project, the ACC managers and key ACC stakeholders should conduct periodic walk-throughs of the space. One of the most important roles of monitoring is spotting the initial (often difficult to monitor/observe) indications of potentially negative consequences for the success of a construction project. Conducting a walk-through helps to ensure that there are no "surprises" when construction is complete and gives the ACC team a greater feeling of comfort when they move into the space. Walk-throughs are not intended to turn the construction process into a continual design effort. However, some "tweaks" that will enable the future team to feel more comfortable in their work space often can be accomplished without affecting time and budget.

6.5 Commissioning and Activation

For the ACC to open successfully, all equipment, systems, and utilities must be working properly. When the ACC opens, airport personnel must be able to function solely on the new work flows, communications, and processes that have been developed. Two activities should be considered before opening the ACC: (1) commissioning, which is the *verification* that all physical systems are operable, and (2) activation, which is the *validation* that all systems meet the business needs of the ACC.

6.5.1 Commissioning

Commissioning is the process of verifying all (or some, depending on scope) of the subsystems for mechanical (HVAC), plumbing, electrical, fire/life safety, building envelopes, interior systems, co-generation, utility plants, sustainable systems, lighting, wastewater, controls, and building security as specified in the design package.

Commissioning is necessary for both non-complex and complex ACC construction projects. The airport operator probably has a commissioning process, but, if not, the following process is recommended.

A commissioning team and team leader should be selected to perform the testing. Ideally, this team will have been involved with the ACC project since project initiation. Although each airport handles commissioning differently, the basic formula for a successful building commissioning process involves a full understanding of the design document and includes a specifically tailored commissioning scope and plan that incorporates benchmarks for success, a review of design documents, and checklists for achieving the intended design. Review and approval of the commissioning activity by the ACC PM (and ultimately airport management) should precede activation.

6.5.2 Activation

Activation—the process of preparing for the new facility's opening day—is critical in the opening of an ACC. Activation requires many activities and the engagement of airport management, operations, and maintenance staff as the facility moves from construction to operation. A successful activation includes accounting for operations and maintenance preparedness in contracts, schedules, and budgets during the early phases of the project; implementing orientation and technical familiarity training; completing staffing and training; concluding business arrangements such as leases; and preparing and conducting operations and emergency simulations and trials.

Developing an activation plan that tests every system as though it were being used in normal operations is the most important element of activation. The activation plan seeks to ensure that

- Staff are properly trained on the new systems and operational procedures.
- All personnel working in the facility are familiar with the ACC's physical layout.
- New processes, systems, and procedures work as anticipated.
- Construction and infrastructure are 100% complete and commissioned.

More information can be found in *ACRP Synthesis 20: Airport Terminal Facility Activation Techniques* which explores lessons learned during terminal activations at 13 domestic and international airport facilities. Although not specifically for ACCs, the techniques and processes outlined in *ACRP Synthesis 20* can be applied to an ACC.

6.6 Training and Orientation

Training and ACC orientation are critical components in the pre-opening activities of the ACC. Although the actual training and orientation are not, in themselves, difficult to conduct, scheduling such events is often challenging. All of the personnel who need the training and orientation are likely to be engaged in critical airport management activities. Therefore, scheduling staff while giving consideration to maintaining airport operations is important. It must be made clear to all personnel that scheduled training is mandatory—sometimes staff are under pressure from a given situation and decide not to attend training. Arrangements must be made for a reduced staffing composition that meets airport operational needs, but allows for essential training.

Like training, orientation is essential. Orientation for a new ACC has many components that are similar to the orientation for a new employee. A detailed orientation may seem unnecessary for personnel who are longtime employees of the airport. However, this could be the last opportunity for airport management to ensure that all employees are fully aware of the goals, objectives, and expectations of the ACC. At the least, the following items should be discussed in an orientation (depending on the facility, the functions being consolidated, and the number of new systems and technologies):

- Mission, goals, and objectives of the ACC.
- Expected culture, vision, and values of the new facility.
- Logistics of the new facility (e.g., parking and access control and break rooms).
- Organizational relationships, reporting hierarchy, and inter-organizational communications. Situational awareness and its importance and how the situational awareness template works. Each new technology system, how they are integrated, and what is expected from each system in a properly working environment.
- Emergency situations and irregular operations and how the ACC will function in such circumstances.
- Use of workspaces, hygiene requirements, locker etiquette (where provided), kitchen rules, and other factors important to employees.

In addition, the ACC CONOPS should be provided, along with an explanation of the document's structure and the document's importance in ensuring that the ACC is successful.

6.7 Warranties

ACC contractors should provide all post-installation services and equipment necessary to maintain the installed system equipment and software in an operational state. The warranty period should be specified in the supply contracts and should begin after formal written acceptance of the system by the airport. The warranty period should include all labor and preventive maintenance traditionally included in the maintenance period at no additional cost to the end user.

SECTION 7

ACC Technology

Twenty-first century technology, which is at the heart of virtually all airport operations, in almost every instance, either produces communication as a byproduct of its core function or has been developed specifically as a communications tool. Similarly, technology is the fundamental tool in an ACC. Although many decisions go into developing or expanding an ACC, no decision is likely to have as much of an effect on the success of the initiative as the selection and implementation of the technology necessary to achieve the goals of airport management when it decided to proceed with an ACC project.

In developing its ACC approach, the airport operator will have three primary considerations. First, choosing the proper technology or extending legacy technology is one of the biggest challenges in producing a successful ACC project. An ACC is no different than any other technology project and should be approached in that manner, with one exception—The ACC, itself, is viewed as a system. A proper ACC IT system architecture will show many subsystem components, integrated to work in a concerted fashion to channel data into a central repository, convert it into information, and provide outputs on which decisions can be made by airport management.

Second, the underlying infrastructure on which the ACC operates is of equal importance to the communication technology. Infrastructure considerations include the network on which all of the applications are transmitted, as well as the data center and related telecommunication rooms. The ACC receives information from a range of sources and transmits information to designated users within and, often, beyond the ACC. A properly functioning communication network ensures rapid and reliable transmission of data, is resistant to compromise, is secure, has redundancy, and is conducive to rapid fault detection and repair. Although the range of network-related technology issues dealing with implementing a communications network (e.g., bandwidth analysis, communications security, network topology, transmission protocols, reserve capacity, and transmission media) are beyond the scope of this Guidebook, they must be addressed to establish an effective ACC communication environment. The passive infrastructure that includes the data center, telecommunication rooms, fiber and cable, and all of their supporting elements (e.g., backup power, redundant paths, and proper environmental controls) are an essential for ensuring the ACC operates effectively.

Third, a substantial amount of data will flow into the ACC. Sorting through that data and converting it to actionable information in a timely manner will be one of the greatest challenges to the ACC personnel. Conversely, it is not possible to implement applications to capture all of the data necessary for decision-making in an airport. Information will still flow from non-technology sources. Absorbing all of the information is perhaps the greatest challenge in a modern ACC. Airport and ACC management must be acutely sensitive to managing this avalanche of data from the day the ACC opens and throughout the life of the ACC.

All of the best practices in developing a technology application should be applied to the ACC as a whole. These include the following:

- Developing a functional requirements document (FRD)
- Creating an ACC systems architecture
- Choosing the right products for the ACC environment
- Customizing and modifying applications
- Integrating applications
- Performing system and user testing
- Training users
- Implementing
- Operating and maintaining

In this Guidebook, Section 4 describes the role of the CONOPS. The CONOPS may serve as the FRD for all technology decisions in smaller, less complex ACCs. In larger ACCs with more complexity and the integration of many airport organizations, developing a full FRD based on the CONOPS, but with more detail for each ACC function is recommended. Each ACC function will have been outlined in the CONOPS with its data requirements, inputs, and outputs. These functional descriptions will help determine the technology needed for the ACC.

7.1 Establishing a Communications Infrastructure

In recent years, significant developments in communications technology have occurred that affect ACC design, including

- Stricter and more extensive security measures.
- Emergence of an information-centric model for airport operations that connects all stakeholders and can deliver content-sensitive information over both wired and wireless links.
- Integration of sensor data, alarm data, video imagery, and geographic information to enhance operations management.
- Greater situational awareness capability to enhance the ACCs ability to manage both normal operations and incidents.
- Integration of intrusion-detection, access control, CCTV, and other security functions with the airport IT network and cable plant, along with an increased emphasis on network security.
- The dominance of IP-based communications, which have or are rapidly replacing older RS-485 and similar standards.
- The need for ACC designs that are compatible with legacy IPv4 products and will provide for compatibility with IPv6 products coming to market.
- Development of converters to permit the reuse of legacy protocol and communications physical cabling.
- Continuing performance improvements in digital equipment and software so that video and voice can effectively and practically be transmitted over a network.

7.2 Communications Infrastructure Relationships

A networked ACC must provide a secure environment for interconnecting various stakeholders. Figure 7-1 illustrates some of the relationships that can be involved, including domains outside of the network (e.g., trunked analog radio systems used for public safety radio voice traffic); PABX (private automatic branch exchange)-based wired telephony; cellular telephony, which may be used for airport functions, but which connects many off-airport stakeholders and

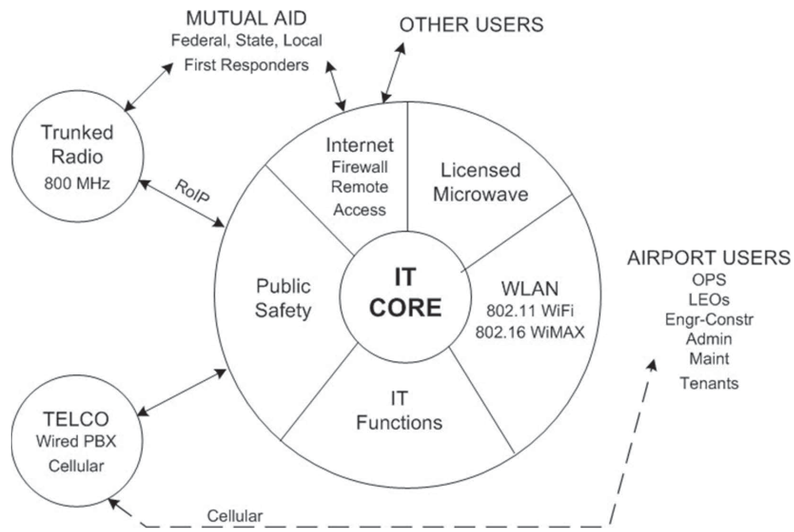

Figure 7-1. Communication relationships.

first responders; and the Internet, which may be used for remote access to network resources and workgroup messaging.

Figure 7-2 illustrates the functions which the ACC should be capable of delivering and the user groups that need them. This model assumes a shared airport IT environment, but it also applies to private networks where the private network interfaces to the shared IT network for more complete coverage.

The ACC communications network transmits information, including data, voice, and video communications, from various sources. It is a good practice to share information with other stakeholders involved in normal operations and incident management within the required security

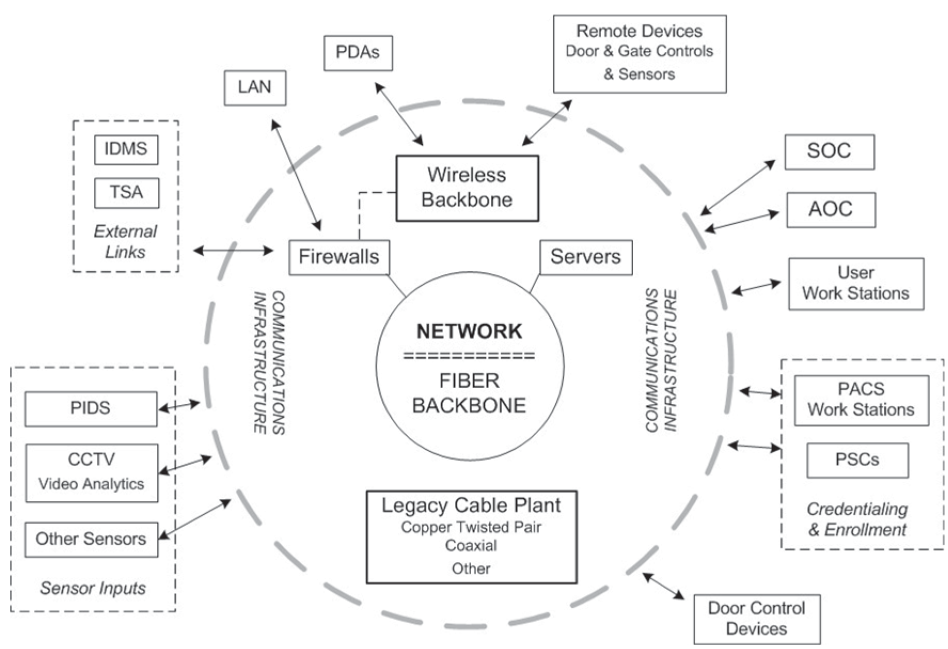

Figure 7-2. Communication services.

protocols. Identifying what information is required by each party and how to best provide for information sharing (including identification and authorization) are major tasks when the ACC is designed. An effective communications network ensures rapid and reliable transmission of data, is resistant to compromise, has redundancy, and is conducive to rapid fault detection and repair.

Several technology issues are relevant to implementing the communication network: bandwidth analysis, communications security, network topology, communication redundancy, transmission modes or protocols, reserve capacity, and transmission media.

ACC communications integrated with other subsystems should be selected to ensure that the ACC operator is provided with a multimedia (i.e., voice, data, and video) presentation of information.

Communications technologies should provide reliable and scalable support to diagnose and resolve system problems that may arise during the lifetime of the ACC. Communications systems can be network-based (to operate over a LAN/wide area network (WAN) or private network) or less sophisticated (using communication protocols that require point-to-point connections using twisted-pairs of cables).

Interfaces between system components should be fully compatible with—and supported by—the communications architecture selected. Downstream compatibility between ACC system components is desirable to enhance the maximum life of the investment.

7.3 Challenges Caused by New Technologies

Modern technology provides vastly improved capabilities and far more information than was historically found in airport operation centers. These new technologies also bring additional challenges to achieving information absorption and situational awareness in ACCs:

- The vast array of new technologies introduced to the airport environment since the beginning of the security/technology convergence era in the 1990s means that today's ACC operator may need to operate many more systems than their 1990s predecessors. Because each of these systems has its own unique interface and method of operation, this represents challenges for both the operator, in using the systems effectively, and management staff who must train operators and provide technical support for these systems.
- The sheer number of new sensors, devices, and cameras can cause information overload for the operator. With some airports managing thousands of surveillance cameras and door access devices, the total number of alarms and events that occur daily can easily become an overload on sensory input, which, in turn, results in inadequate attention to those inputs that demand immediate action.
- It can be difficult to achieve situational awareness, given the challenges of associating large numbers of alarms with cameras, locations, and staff resources in today's large airports. For example, for an operator to understand a situation accurately, they must be able to understand where alarms and events are occurring in the airport, know which video surveillance cameras will provide the best view of the relevant area(s), and know where staff is in relation to the location to dispatch effectively. In large airports that cover millions of square feet of floor space, operators are challenged to grasp geographical locations quickly and correlate them with nearby facilities and activities.

Information overload can serious degrade situational awareness. Approaches that have proven effective include

- **Helping the operator focus.** When possible, limit the number of systems each operator must use so they can focus on those systems. By creating operational roles for staff, they can focus

more closely on specific systems, rather than being a "generic" operator working on many systems at once. Staff should still be cross-trained to be able to use all systems that may be required in the event of role change or emergency.
- **Striving to prevent nuisance alarms.** In many ACCs, some alarms and alerts occur frequently, but are either false alarms or are caused by inappropriate settings in systems. Although operators learn to ignore these alarms, they do subconsciously affect operators, distracting them and causing them to become less sensitive to alarms and alerts overall. Assess alarm/alert settings in all systems to ensure that nuisance alarms are minimized.
- **Leveraging new technologies.** New technologies (e.g., physical security information management [PSIM] systems) can be used to aggregate data on alarms, locations, and resources can help provide a complete "event picture" for the operator and counter information overload.
- **Adding staff.** Additional staff whose sole responsibility is to monitor systems, enter data, and receive information, can free airport operational staff to perform their primary roles.

7.4 Technology Design Considerations

The first and, likely, most important factor to consider is that the ACC probably will be a combination of new systems and the extension of legacy systems. This will require careful examination of all legacy systems being considered for the ACC in terms of their functionality, usefulness, ease of integration into a new environment, the quality of their data, and their acceptance by their current user groups.

7.4.1 Technology Design Process

The functions of the ACC are of equal or greater importance than its form, although form is an essential part of the design process. Examination of ACCs in place makes clear that the functional aspect of the ACC is heavily dependent on the quality of the technology systems that support it. Technology is woven into the fabric of the modern ACC. As a result, proper ACC design requires a technology designer as part of the team from the beginning. Just as architects and engineers are indispensable in the design process, technology designers are crucial to the success of an ACC design.

The time to engage the technology designer is at the beginning of the project. Because the facility is so highly dependent on technology, it is essential to have the services of the technology designer from the beginning stages to help the owner make strategic decisions early. These early decisions significantly affect the success of the project. Consider an ACC project where the technology designer was brought in at the start and discovered problems that required redesign. The space allocated to the data center was insufficient, and the placement of the large-format video displays was inappropriate for the available power and cabling. By addressing these issues, hundreds of thousands of dollars and months of wasted time were saved.

Creating an effective ACC that integrates multiple new and legacy systems and provides information to which the airport has not likely had access in the past is a complex technology undertaking and should be considered as such by airport management. The following recommendations are critical to an effective ACC technology environment:

- Engage the existing airport IT department to the greatest extent possible and from the beginning of the project. IT department staff will likely have the best understanding of the legacy systems, the airport's communication network, security considerations, and other factors important in successfully completing the ACC project.

- Include technology experts, internal or external, as an essential part of the design team in addition to architects and engineers and engage them early in the design process.
- Upgrade, if necessary, networked communications systems in order to transmit information rapidly, reliably, and securely with redundancies for analysis and action, especially with regard to alert and alarm information.
- Employ standards recognized by certified communications and computer network organizations.
- If not already present in the airport, consider the interoperability and flexibility advantages of Voice over Internet Protocol (VoIP) on shared networks.
- Look for the latest technology innovations, such as interconnected wired and wireless links for information delivery; integration of sensor, alarm, video and geographic data; IT network integration with security functions; Internet Protocol-based communications; legacy and future product compatibility through converter use; and the use of mobility where it is appropriate. All of these innovations can enhance situational awareness.

7.4.2 Technology Best Practices

The following best practices are critical in designing the ACC system architecture and should be used wherever feasible:

- **Standards-Based Open Architecture.** Open systems are those that conform to open specifications for interfaces, services, and supporting formats. An open specification, or standard, is a public specification maintained by an open public consensus process to accommodate new technology over time and is consistent and compatible with existing standards. Using a standards-based Open Architecture in the ACC will allow easier integration of airport systems as they are introduced into the ACC environment. Heavily customized software or software that cannot be customized to fit the airport's needs will be difficult to incorporate into ACC operations.
- **Interoperability.** Interoperability is a measure of how well one or more elements of the ACC—particularly its technology—can work with other systems and components. Ideally, interoperability should occur in a plug-and-play context (i.e., without having to modify electrical and mechanical interfaces or write software patches) and should be implemented using tested, proven open standards. Interoperability is primarily an issue of communications among system components. It is increasingly important that technology systems, both legacy and new designs, are linked over facility information networks.
- **Legacy System Integration.** Most airports have existing systems and supporting infrastructure. The two most prevalent types of legacy systems are physical access control systems (PACS) and video management systems. These systems typically have well-defined interfaces that allow access to system data. An ACC can use these assets by integrating with the published interfaces. During the design process, identify what legacy systems should be integrated with the ACC and the extent of the integration desired (e.g., just accept data from the legacy system or have full control of the legacy system) and provide the necessary documentation (including interface specifications and equipment locations) followed by development of a progressive plan for early integration of critical legacy systems.

7.5 ACC System Architecture

A system architecture is the conceptual model that defines the functionality, processes, structure, and expectations and provides a graphical, as well as written, description of a system structure. An architecture description is a formal document and representation of a system, organized to illustrate how the system operates, how its components interact, and the expected business benefit for each application in the environment. An ACC system architecture will comprise several system components, including legacy systems and new systems that will work in concert to create a system in itself.

A fully developed ACC system architecture will include all of the following:

- The fundamental organization of the ACC system, as illustrated by the components contained, their relationships to each other and to the environment, and the functional requirements governing their design and functionality.
- A graphical representation of the ACC system, including a mapping of functionality onto existing and planned hardware and software components, how the software architecture and the hardware architecture interrelate, and the staff interaction with each of these components.
- The relation of all system components to each of the airport organizations or functions that are functioning in the ACC. Often referred to as a "line-of-business" in the system architecture world, each aspect of airport management and operations should be included in the ACC system architecture.
- A description of the design, function, and data of each component of the ACC. If a legacy system, the documentation should include the same information used when the component was initially acquired by the airport, focusing on those aspects of the component that have particular relevance to the mission of the ACC.
- A description of the design and function of current hardware and software that supports the networking capabilities of the ACC, a description of long-range plans and priorities for future purchases, and a plan for upgrading and/or replacing dated equipment and software.
- The most important, top-level, strategic decisions about the future structure of the ACC.

Although small or even medium-sized airports may not develop a full-blown ACC system architecture, the components described above should be developed to the extent corresponding to the sophistication of the ACC.

Upon initial review, developing an ACC system architecture may seem like considerable work; however, most airports will find that the building blocks of a usable ACC system architecture have already been created. Using documentation developed during the acquisition of each ACC-bound legacy system is a good start. Network design, layout, and the physical layout have probably been developed by the airport's IT department. The physical location of data centers and telecommunication rooms is well known and probably been graphically defined. The CONOPS provides the basis for the functionality to be contained in the ACC. All of these disparate artifacts combine to create a solid foundation for an ACC system architecture.

7.6 ACC Applications

Virtually any applications existing in the airport in the current environment, as well as a host of new systems, are candidates to be included in the ACC. The systems chosen for placement in the ACC environment should reflect consideration of the following questions:

- Foremost, does the application provide operational or critical communications necessary for the ACC to fulfill its mission?
- Does the application have the functionality to integrate with other ACC systems efficiently and effectively? (Older applications, particularly those with proprietary software, may not be easily integrated with other ACC applications.)

- Is the data contained within the legacy application of sufficient quality that, if incorporated into the ACC, it will provide ACC personnel with accurate, timely, and relevant information?
- Is the application slated for replacement in the near future due to obsolescence? (If so, it may be better to conduct the replacement of the application specifically with the ACC in mind.)

Various types of applications that should be considered for integration into the ACC system design (either wholly or tangentially) are discussed in the following subsections.

7.6.1 Airport Operations

If the airport operator chooses to manage airport operations from the ACC, it will need support applications to provide the information necessary to effectively control airport operations. The following systems are used in managing and operating the airport and are candidates for communicating directly to the ACC or providing the ACC an information feed:

- **Airport Operational Database (AODB)**. The Airport Operational Database (AODB) is the "Airport Information Center" and is the central database or repository for all operative systems and provides all flight-related data accurately and efficiently in a real-time environment. The Airport Operational Database (AODB) is the "Airport Information Center" and is the central database or repository for all operative systems and provides all flight-related data accurately and efficiently in a real-time environment. The AODB is the primary repository of data related to flight operations and the airport systems that support airport operations. An AODB is created from many sources. The AODB acts as a data warehouse, storing and disseminating data from many of the airport's applications, and provides the focal point for integration of applications throughout the airport environment. If the airport operator has decided to use its ACC for airport operations, the AODB probably will be at the heart of the overall ACC system architecture.
- **Resource Management System (RMS).** A resource management system is the primary tool for managing an airport's most important resources and is the focal point for managing an airport's operation. The RMS provides for the management of non-mobile resources such as airline ticket counters, gates, and baggage assets, as well as kiosks operating in both common use self-service (CUSS) mode and dedicate-use mode.

  RMS is a primary component of an airport's common use system and enables airport personnel to handle routine tasks effectively and efficiently. In most cases, RMS is directly connected to the airport operational database (AODB).
- **Gate Management System (GMS).** A GMS is the primary manager of gates and assigns and allocates passenger and freight flights to specific gates, assigns catering for remote stands, and assigns jetways, gate lounges, buses, and other services. Gates can be common use (shared) or dedicated (assigned to one airline). Depending on the functionality of the ACC, a GMS may be a core application for consideration as part of the ACC's technology foundation.
- **Ticket Counter Management System.** When not handled by an RMS, an airport may have a separate management system that assigns ticket counters to airlines.
- **Baggage Carousel Management System.** This system may be included as a sub-module in the RMS or as a standalone application, depending on the airport's technology environment. It assigns baggage carousels to airlines for their incoming flights.
- **Common Use Passenger Processing Systems (CUPPS).** CUPPS is an internationally recognized software application that allows for the provisioning of a shared airport operational platform supporting all resident airlines on a single set of common devices. This includes workstations, boarding pass and ticket printers (ATB), bag tag printers, boarding gate readers, and other devices that may be shared by airlines. CUPPS allows flexibility in the allocation of airport resources (e.g., ticket counters and gates) to individual airlines. CUPPS may also

include IP telephony configuration for the user airlines and may extend to visual display units and other airline signage systems. With CUPPS, virtually all of an airport's interactions with an airline can be managed centrally from the ACC.

- **Security Checkpoint Monitoring Applications.** An increasingly valuable application to have in the ACC is security checkpoint monitoring. Using technologies such as Wi-Fi, Bluetooth, video analytics, and even social media (or a combination of any of the four), an ACC can have direct surveillance on checkpoint status, especially during peak periods when lines can grow to be unmanageable. The application also provides a way to help manage other airport assets affected by passenger throughput.

7.6.2 Baggage Handling Systems

It is not likely that baggage handling will be coordinated out of an ACC; however, there may be instances when it is important to have an information feed from the central baggage handling console to the ACC for ACC personnel to have firsthand familiarity with ongoing issues.

7.6.3 Flight Operations

Several systems could provide useful communication to the ACC including the following:

- **Visual Docking Guidance System (VDGS).** Where the VDGS is integrated with the airport CUPPS or AODB, it will provide valuable data to the ACC. The VDGS provides pilots with aircraft parking assistance, which is crucial in climates where weather affects flight arrivals.
- **Daily Operations Log and Emergency Checklists.** This system, typically used by an airport duty officer for managing airport operations, includes access to emergency checklists in the event of a ground, air, or other operational incident. This system can be automated in situational awareness management software (see below). For an ACC with substantial operational control, this system will be a critical component of the ACC's architecture.
- **Runway Monitoring and Surface Movement Systems.** This application monitors aircraft and vehicle movement. Depending on the ACC functionality, it is useful for ACC personnel to be aware of all movement on an airfield. Where these systems are used, special video output screens should be set up so that movements can easily be monitored.
- **Noise Monitoring System.** This application provides flight path data along with a measurement of aircraft noise along its path. If an ACC receives inquiries from the public regarding noise, this is valuable information to have in order to provide an immediate response.
- **Weather Monitoring and Forecasting Systems.** These applications provide all of the weather information needed by an ACC to understand the current weather conditions, as well as projecting potential operational problems as a result of weather conditions. For example, an ACC with responsibility for de-icing operations will have better insight into the potential for planning the use of de-icing bays and de-icing trucks.
- **Runway Surface Monitoring Systems.** Such systems can direct personnel to deal with foreign object debris or, through sensors embedded in the runway, determine the presence of ice or standing water—all of which may affect airport operations.

7.6.4 Landside Operations

Although landside operations encompass various activities away from flight operations, they can greatly affect or be affected by what is happening on the airfield. For those ACCs engaged in not only acting as a communication node, but also using the information gathered to make airport management decisions, the following systems will be of use to ACC personnel:

- **Parking Systems.** Although it is unlikely that an ACC will manage a parking operation, having insight about parking availability, lane control issues (e.g., backups on entry or departure), and other parking-related functions may be of use to ACC personnel. If the airport has a specific Parking Space Management System (PSMS), a direct feed to the ACC could be beneficial.
- **Surface Vehicle Monitoring System (SVMS).** Similar to airfield operations, it may be useful for ACC personnel to have situational awareness of airport vehicles landside. A direct feed from the SVMS could be valuable in high traffic or emergency situations.

7.6.5 Airport Communication Systems

The most critical airport communications are those systems whose primary functions are delivering communications throughout the airport environment. These systems may reside on the airport's IP network or, in the case of analog telephone systems, on external resources provided by local carriers. Especially for the former, airport management must properly plan for the load of these systems on its network because they can easily saturate a weak network, especially when emergency communications rise to a level far greater than with normal operations. Although these systems are not considered specifically ACC systems, because they are used throughout the airport, they are of vital importance to the ACC and the ACC system architecture must provide special consideration for the ACC to ensure that proper resources are available at all times during normal, as well as irregular operations and emergency situations.

- **Email.** Email is a critical communication tool for airport operations. Though its timeliness may be debatable, it remains an essential tool. Although the ACC is no different than any other node in the email infrastructure, the airport may want to establish some general email addresses for various ACC functions or the ACC that can be used as repositories for email whose destination is a function and not a person.
- **Trunked Radio, Land Mobile Radio.** The ACC will likely need direct access to any radio system being operated in the airport and should have its own console. Trunked radio systems, typically operating in the 800-MHz band, enable dispatchers to communicate orally with the field units and for field units to communicate orally with other field units over portable and mobile radios. To support an ACC, additional radio dispatch consoles will be required. The new consoles should support radio communications on the airport trunked radio system, as well as various mutual-aid channels to support regional interoperability.
- **Automated Configuration Management Tool.** An automated configuration management tool should be used as part of the radio configuration. This tool should track changes to the system architecture, including new or removed equipment and updated software. Complex user groups can be set up for a single user to monitor and communicate with multiple user groups to satisfy specific operational parameters. The airport's radio system may also be part of a larger city, county, or state system. This is an essential communication tool, particularly during emergency situations that extend outside the boundaries of the airport.
- **VoIP**. In technical terms, VoIP technology treats a voice call as a data transmission. The network sees a "packet" of voice in the same way as data and transmits it over a LAN instead of through a traditional private branch exchange (PBX) analog phone system. When a call is sent to a location internal to the LAN, it stays under the control of the data network. When a call is sent to an external location (off the LAN), the call is routed to an outside line or trunk. Using the full capability of a VoIP can greatly enhance internal and external ACC communications. Too often, VoIP is installed and the users receive little or no training. It is good to train all ACC personnel so that they can take advantage of all functionality.
- **Centrex and Private Branch Exchange Phones (PBX).** Although most airports have implemented VoIP (which provides voice transmission over a data network), the airport

should maintain a sufficient number of analog phones in the event the network suffers a major outage.

7.6.6 Airport Safety and Security Systems

Perhaps the most common applications found in an ACC are those dealing with security and public safety. Additional information on the operations of the public safety and security function are provided later in this Guidebook. Applications that may be part of the ACC system architecture are as follows:

- **Command and Control Center (C&C) Systems.** The C&C system manages and coordinates an airport's response to all varieties of incidents. The C&C system is integrated with numerous other systems and aggregates data from all of them to provide actionable information to management. When developing the ACC system architecture, special attention should be paid to the interaction between the C&C system and other airport applications.
- **Mobile Command Post Systems.** These field-based mobile sub-units of the C&C Center duplicate the functionality available in the primary C&C Center and are used during emergency situations. The mobile command systems provide the ACC with a clearer picture of what is happening in a different geographic part of the airport.
- **Video Surveillance Systems.** The "eyes" of the ACC are typically an integrated video surveillance system, using various cameras distributed throughout the airport property. CCTV is an integral part of monitoring physical security for any airport. The CCTV system is a collection of cameras with varying functionality—pan, tilt, and zoom capability, infrared, and high definition. Each of these cameras can provide data to the ACC for security, management, and operational purposes. The ACC may have a separate viewing room for public safety cameras and will likely have large-screen displays for airfield, roadway, and terminal monitoring.

  From an ACC perspective, a highly functional video management system (VMS) is essential. In larger airports where the number of cameras can easily exceed a thousand, managing them is impossible without a VMS. If an airport operator is considering the purchase of a new VMS, the operator should consider the needs of the ACC when making an acquisition decision. An important tool in the VMS is video analytics. Video analytics can be used for a host of safety, security, and operational situations. The CONOPS is likely to have identified scenarios where video analytics can add considerable value to situational awareness.
- **Physical Access Control Systems (PACS).** The PACS controls staff and vehicle access to secure and sterile areas throughout the airport. PACS are controlled by federal regulations and are a critical component in airport security. The PACS should be operated from the ACC or the ACC should receive all PACS alarms. Some PACS can integrate with CCTV systems to bring up a video feed for a door and geographic location. At larger airports, PACS alarms may sound almost endlessly, especially if there are many doors. PACS configuration in the ACC might be to show only alarms for doors directly onto the airfield or other critical locations.
- **Badging Systems.** Badging systems provide for airport ID cards that integrate with the access control system. Badging systems are not likely to be found in an ACC, but access to the ACC should be carefully monitored so that only authorized personnel are allowed to enter and leave the ACC. Before the ACC is opened, it should be decided who will have access to the system. Typically, this is considered to be role-based access control, permitting only certain personnel in specific functions with the access to enter.
- **Perimeter Intrusion-Detection Systems (PIDS).** These systems detect alarms and initiate responses for breaches of perimeter security. PIDS may include microwave systems, sensors in the fence, CCTV, infrared detection, and other technologies. PIDS, along with fences and walls, are the first line of defense on the airport's edges. The ACC should be able to monitor all activity that has been registered on the PIDS. Establishing a PIDS workstation in the ACC

is not difficult. If the ACC also contains a security operations center (SOC), this application is certain to be included.

7.6.7 Emergency Response and Notification Systems

When an emergency unfolds at an airport, two major streams of communication are likely to occur. The first stream includes the communication to emergency responders; the second includes information and directions to the greater public. Both communications streams are likely to be governed by codes, described in standards, and involve best practices as described in the following sections.

7.6.8 Public Emergency Communications Systems

The diverse population and airport environment combine to pose many potential challenges when communicating emergency messages to the public. The population will include the traveling public, airport employees, airline employees, tenants, and various vendors and contractors. This varied population will be have different agendas whether individuals are business travelers, international families on vacation, part-time retail employees, or contractors performing work. These individuals will need audible and visual messages in various media and perhaps multiple languages. The airport environment may be unfamiliar to the traveling public who may not understand where to go, particularly for unfamiliar events. Also employees may be familiar with only certain parts of the airport. Although a significant portion of the ACC resources will be devoted a central terminal area, most airports are self-responding with an onsite PSAP which will involve response to all parts of the airport campus. In addition to these challenges, the airport campus will have various types of systems, software and hardware will not all be the same age, and their will be different levels of coverage. Consult *ACRP Research Report 170: Guidebook for Preparing Public Notification Programs At Airports* for excellent information on this topic.

The ACC needs to take a holistic view of signaling and informing the public during emergencies so as to ensure accurate, consistent, and timely information is provided. The ACC may have access to the following communications systems or methods:

- Fire alarm
- Public address
- Digital signage
- Television
- Radio
- SMS text messaging
- Live audio feeds
- Automated voice calls
- Faxes
- Emails
- Web postings
- Desktop notifications
- Social media alerts

Although not always feasible, the ACC should strive to simplify the process to a single stream using a unified emergency communications system. This will allow the airport to more accurately anticipate, plan, and minimize response time based on common or anticipated emergencies. The central part of the unified communications system is an interface to initiate either preprogrammed or ad hoc emergency communications with any of the above systems and methods.

For example, initiation of a partial or full terminal evacuation, if it does not happen on site via a fire command center, would be initiated to trigger the fire alarm system visual strobes, voice evacuation announcement (through fire alarm or paging, depending on the locality), textual messages through digital signage and television systems. Based on the programming, the same written and spoken message would be distributed to the correct subsystems for the correct portions of the buildings. Following the evacuation, the airport operator will need a way to inform the public that it is safe to reenter the terminal, how to do so, and (potentially) why the event occurred. Depending on whether or not an EOC was activated, direction will come to the ACC which can lean on the single interface to initiate a preprogrammed all-clear signal, potentially including ad hoc information.

From the system perspective, the keys to design are to understand what could be used for the single interface, applicable code requirements and interfaces to other systems for message distribution, including use of text-to-speech conversion and protocol compatibility.

Codes related to the application of these systems are typically adopted at the state, local, and airport level and may include *NFPA 72*, "National Fire Alarm and Signaling Code," which includes requirements for emergency communications systems (e.g., voice evacuation, distributed recipient systems, wide area systems, and mass communication systems); and *NFPA 1221*, "Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems," which includes requirements for public emergency services communications systems and facilities.

Although the systems allow communication to occur, the airport and emergency response plan may be the greatest inputs to the system. Airport input will involve not only the local authority having jurisdiction, fire department, and public safety, but also management, IT, facilities maintenance, and, in some cases, public relations and legal departments. All of the groups that may be called to the EOC should have input, because they will rely on the ACC to distribute public communications in an emergency. Methods for public safety-related communication include

- **CAD.** This technology for dispatching law enforcement personnel or emergency services can either be used to send messages to personnel in the field (through a mobile data terminal [MDT]) and/or used to store and retrieve data (e.g., radio logs, field interviews, client information, and schedules). A dispatcher may also provide call details to field units over a two-way radio. CAD typically consists of a suite of software packages used to initiate public safety calls for service and dispatch and maintain the status of responding resources in the field. An ACC may have a CAD workstation solely for monitoring airport activity. Depending on the airport's law enforcement arrangement (internal or external), placement of the CAD within the ACC is likely to be based on current guidelines and procedures.
- **Fire Suppression & Alarm Systems.** These systems detect smoke and/or heat and initiate an alarmed response to the airport's C&C center. Irrespective of where the main alarms are sounded, **fire suppression and alarm systems** are an important tool for ACC operations to be able to monitor fire and smoke events as such events usually affect other airport operations. In the case of smoke and/or heat detection, these systems should interface with the audio and visual paging notification system.
- **The Emergency Response System**. These methods and systems coordinate an airport's response to major incidents such as air crashes (both on and off the airport), terrorist and criminal activity, and other incidents such as fatal wrecks or accidents involving staff, passengers, or members of the public. This system should also integrate with natural disaster responses and fires.

7.6.9 Airport Facilities and Maintenance Systems

Airport facilities departments play an important role in operational readiness. Facility- and application-related technology can provide important data and situational awareness to the ACC.

7.6.10 Building Management Systems (BMS)

Building management is a key component of intelligent building design, where several subsystems tightly integrate so that they can operate with much greater efficiency, anticipating changes in weather and adjusting for the number of people in a given location, and so forth. Managing the physical environment from the ACC allows airport management to meld facility status with other ongoing operational considerations (e.g., reduced flight activity, weather anomalies, or even emergency situations). BMS manage the electromechanical systems in a facility, including security, lighting, cooling, heating, and ventilation. These are also known sometimes as HVAC systems. Unlike typical business applications, a BMS will rely on embedded sensors and other devices for input to the system. Such devices include thermostats, fire detection sensors, and sprinklers. BMS use IP for data transport so the airport's campus LAN can be used for interconnecting building systems.

- **Electric Power, HVAC, and Lighting.** All modern infrastructure technology likely has a control center for its management. For newer systems operated on an IP network, feeding alarm sensors to the ACC provides the ACC with immediate situational awareness on critical events in the airport. In older facilities, supervisory control and data acquisition (SCADA) systems are more likely to be found—these are more difficult to integrate into the ACC system architecture. SCADA systems are often "hard-wired" directly to a control center, typically in a maintenance facility, and it is difficult to have additional feeds go to other locations.
- **Computerized Maintenance Management Systems (CMMS).** CMMS is software used to schedule and record operation and preventive/planned maintenance activities associated with facility equipment. The CMMS can generate and prioritize work orders and schedules for staff to perform periodic/planned equipment maintenance, as well as to log and schedule "trouble" calls. Upon completion of a work order, performance information, such as the date work was performed, supplies/inventory, and staff-hours expended, typically is loaded into the CMMS for tracking, to support future operations/planning. Integrating a CMMS with a GIS gives the airport and the ACC a spatial view of what maintenance operations are occurring in the airport at any one time. The CMMS also can be used to track maintenance trouble spots over time.

  Having access to this information could be valuable in an ACC as airport management tries to balance a wide range of activities that could be occurring in the same place simultaneously. In some ACCs, the maintenance call takers are part of the ACC, giving even more insight into existing maintenance issues.
- **Moving Walkways and Elevator Monitoring Systems.** Most modern conveyance systems identify problems before they occur. These systems detect deteriorating components and intermittent anomalies and note the small issues that might go undetected until they cause service. Typically, diagnostic software monitors elevators and walkways continuously and sends data to a central console in a machine room. These systems are also capable of sending similar information over a network to off-site locations, which could include an ACC if the ACC needs to manage potential conveyance issues.
- **Geographic Information System (GIS).** A critical function of any ACC is the ability to associate incoming data blocks with a spatial identification. Knowing "where" is as important in an airport environment as knowing "what" and "when." For this purpose, an airport must consider how to fully incorporate its GIS capability into its ACC. A GIS is a computer application designed to capture, store, and display information related to geographic coordinates in or around the airport's location. GIS is used to depict various data points that are spatially connected, on one visual display, so the user can more easily see, analyze, and understand patterns and relationships. With GIS technology, airport management can compare the locations of different activities to discover how they relate to each other. For example, using GIS, the same display could depict ongoing construction activity with the location of active concessionaires

to determine the effect on terminal business. Increasingly, GIS is used to depict the airport environment in 3-dimensional images. This type of display can greatly assist airport management in understanding its physical environment and how the environment has changed over time. Having GIS information available in the ACC is essential for ensuring that decisions from the center reflect the most accurate and illustrative information possible.

7.7 Airport Technology Infrastructure Systems

All of the applications used by the ACC will "ride" on the backbone of the airport's network. The ACC's data-at-rest and data-in-motion will reside/flow in the airport's data centers and telecommunication rooms. The technology infrastructure can easily be overlooked by airport management, because, for the most part, the infrastructure is not visible (except for the data center and telecommunication rooms), but the technology infrastructure is critical.

7.7.1 Passive Infrastructure

The airport's passive infrastructure refers to its physical network, including all of the physical rooms that house network and data processing and storage equipment. The network aspects of the passive infrastructure are the assets referred to in OSI Layer 1, which consists of the basic networking hardware transmission technologies of a network. It is unnecessary to delve deeply into this topic; however without the necessary resources at this level, the ACC has little chance of being a successful initiative and airport management is wise to ensure that the necessary components are robust, scalable, and redundant. Details follow:

- **Structured Cabling System (Passive Infrastructure).** The primary purpose of this system, also known as the passive infrastructure, is to provide the physical media that allows for the interconnectivity of all airportwide communications systems. More specifically, this interconnectivity is accomplished through the use of fiber-optic and/or copper cabling routed between each of the communications rooms throughout the airport's premises and from the telecommunications rooms to the user workstations.

  The telecommunications rooms, located throughout the airport, serve as the distribution points for the end users of various airport systems. Examples of such airport systems include telephone sets, courtesy phones, pay telephones, security, multi-user flight information display system (MUFIDS) monitors, light-emitting diode (LED) devices, CUPPS, CUSS terminals, building management system control units, administrative network workstations, wireless access points, and information kiosks. All of these systems are served from the telecommunications rooms; therefore, it is good practice to properly account for the co-location of these systems when planning cable routing, component placement, power, cooling, and similar future requirements. The cabling routed between communication rooms is known as "backbone" cabling, whereas the cabling to user workstations is "station" or "horizontal" cabling.
- **Cable Management System (CMS).** Managing the passive infrastructure is an essential component of the communications infrastructure. A CMS provides a cable asset database for tracking cable terminations and users. Organizations generally move, add, or change at least 30% of communications cabling each year. Eighty percent of the time and cost of such changes is spent in rediscovering cables. Therefore, a CMS provides a return on investment by greatly reducing MAC costs and resource usage.

7.7.2 Network Systems

Network Systems provide the bandwidth over which various communication systems distribute and share data. Bandwidth refers to the amount of data that can be transmitted over a given network segment during a specific period. The advent of reliable, secure Virtual Local Area Network (VLAN) technology and gigabit speeds for bandwidth allow airports to provision a single LAN that cost-effectively serves all of its communications systems needs.

- **LAN.** LANs are typically confined to single buildings or small groups of buildings on campuses such as those at airports. The networking technology implemented determines which data transmission methods can be implemented and the upper limit of the speeds available for transmission. Therefore, the choice of networking technologies in a LAN design is critical to developing an overall system that supports existing (legacy) systems, as well as future systems and applications. The current "standard" for backbone applications is 10-GB Ethernet.

  An ACC can be network-based to operate over a LAN/WAN or over a private network. ACC communications should be scaled for the size and complexity of the system. Operational requirements for voice, data, and video services should be established in the CONOPS well before system design begins. Selection of system architecture and system technologies should ensure that the design will meet current requirements and be scalable for future requirements and will perform reliably over its lifetime and that support will be readily available to diagnose and resolve system problems that may arise.

  Translating system architecture into a design should address data integrity, data security, full connectivity and security among all system components, appropriate system monitoring and diagnostics, and growth potential. Where system components are supplied by different vendors, the design specifications must provide for proper integration, and post-installation testing must validate that all components are properly integrated and realize the required performance. The system provider should also be contractually bound to support, maintain, and ensure that all components are properly integrated.
- **Wi-Fi (Multi-Frequency Antenna, Radio Spectrum Management Systems).** When airport communications include wireless elements, planning for an ACC must also consider FCC rules and regulations. The FCC's rules and regulations are in Title 47 of the Code of Federal Regulations (CFR). The FCC regulates broadcast stations, amateur radio operators, and repeater stations, as well as commercial broadcasting operators who operate and repair certain radiotelephone, television, radar, and Morse code radio stations.

  Under FCC rules, certain devices, commonly known as unlicensed devices, are exempt from regulation and may be freely used, so long as they conform to technical standards established in Part 15 by the FCC. For wireless LANs operating in the Wi-Fi bands of 3 GHz and 5 GHz, peak power and radiated signal strength limits have been established that limit wireless coverage.

  In addition to commercial cellular and wireless LAN services, other types of commercial services widely used for everyday non-critical communications generally fall into one of the following categories:
  - Specialized Mobile Radio (SMR) may provide mobile dispatch and data communications services. Users of SMR systems can communicate between single radios or simultaneously to a group of users. Interoperability within the SMR service falls under the "single system strategy." Unfortunately, interoperability outside of the service may be limited due to the lack of common standards and protocols, which is further compounded by the fact that SMR systems are licensed across three different frequency bands (220 MHz, 800 MHz, and 900 MHz).
  - Mobile Satellite Service offers digital broadcast capability, which allows the dispatcher to speak to a single user, a group of users, or all network users. Users can, in turn, communicate with members in predefined talk groups. Users within a talk group can communicate via a one-way group call or through standard two-way communication. Interoperability is provided only between users of the system or to individuals connected to the public switch telephone network.

- **Metropolitan Area Network (MAN)/Wide Area Network (WAN).** A MAN is a computer network larger than a LAN, covering an area of a few city blocks to the area of an entire city, and possibly including the surrounding areas. The WAN provides the connectivity from the LAN on a campus to points outside the campus, such as data centers in other cities. Typically, today's WANs use technology similar to LAN-based switches. However, a WAN connection, unless properly configured and managed, could introduce delays and instability, which could affect the user through the reliability or latency of a connection. Airports do not generally have to develop WANs because most of the airport applications and systems will only communicate at the campus level through the LAN.
- **Virtual Private Networks (VPN).** In virtual private networks, the equivalent of a closed user group, users gather together by virtue of some common characteristics over a common domain. This network can run on dedicated equipment or through a shared infrastructure provider such as a Telco. VPNs provide a secure environment that allows individual groups of users to share data.
- **Network Management Systems.** Network management is a critical function. It is either reactive or proactive. Reactive presupposes a user reports a fault and then a technician is dispatched. Proactive means that the IT asset is monitored (for which bandwidth needs to be allocated), and the watching agent intervenes without a user calling in the fault. This requires definition of an operations support model with links to customer and vendor service levels. Many vendors offer network management systems.
- **Network Security Management**. An airport should implement layered security solutions with firewalls and intrusion-detection/intrusion prevention (IDP/IPS) systems at the edge of and inside the network. The airport should also implement industry-recommended practices in virus protection and patch management. Security typically already exists at a device level (e.g., workstation), application level (i.e., log-on password), and at a network level. The most vulnerable parts of a network are the interconnections, whether they be VPN connections or wireless access points. Good network design and careful management will mitigate intrusion and unauthorized entry. Several third-party companies can assist in the intrusion-detection arena. Physical security plays a large part in the overall network security plan. Networking equipment should be in rooms that are physically secure.

7.7.3 Network Design

This Guidebook is not intended to provide a full discussion of the network requirements for an ACC. However, the design of the network on which an ACC will conduct its critical functions must have certain attributes, and airport management must ensure that the network meets the following general requirements:

- **Performance.** A well-designed network shows consistently high performance in application response time, the variation in response time, and other performance parameters.
- **Resilience.** The network should provide a resilient platform for the applications it supports. A highly specified network might have to meet an availability target of 99.99% or higher for all applications. Ideally, the failure of any one link or networking device should not result in the loss of sessions or services. Switches and other network devices should have hot-swappable blades and power supplies. Automatic failover to an alternate path should occur within a time interval short enough to minimize the effect on existing sessions. This interval can be defined as the span between when a network topology change (such as the loss of a link) occurs and each device on the network becomes aware of the change. Well-designed networks are characterized by consistently low convergence times.
- **Scalability.** A scalable network can support growth to a projected set of functions and/or capacity over a stipulated period without having to be radically redesigned and with minimum

obsolescence of core equipment. A scalable network can handle the addition of users, network nodes, and sites, as well as new applications with increased bandwidth needs. Vendors should be required to describe how the projected functions and/or capacity levels will be achieved and the resulting effect on any proposed systems. The network design should permit the addition of new nodes and users with the addition of a new section or block to an existing structure that serves as the core or backbone of the network.

7.7.4 Network Standards

Standards are essential for communication systems and computer networks to function properly. In the United States, the following standards are applicable for airports (the appendixes provide a more detailed list):

- The Institute of Electrical and Electronic Engineers (IEEE) publishes standards for networking architectures, such as Ethernet networks; for network devices, such as a network switch or a wireless access point; and for various electrical power, communications, and other equipment and systems.
- The Telecommunications Industry Association (TIA) publishes standards for telecommunication facilities and the cable plants that serve them, in addition to other standards.
- The Internet Engineering Task Force (IETF) publishes standards for protocols and devices that operate over the Internet, including protocols for routing datagrams and VoIP.
- The American National Standards Institute (ANSI) publishes a wide range of standards and often jointly publishes telecommunication standards with the TIA. ANSI and its largely European counterpart, the International Standards Organization (ISO), also publish complementary standards or cross reference their standards.
- The National Institute of Standards and Technology (NIST) publishes standards and guidelines, known as Special Publications, for facility, communication, and network security that are mandatory for federal agencies, unless exempted in PL 107-296, The Homeland Security Act. U.S. airports are generally not obligated to follow NIST standards, but these documents are a significant resource for airports in modeling their own security programs, especially for wireless network security.

7.7.5 Performance

The operating environment must ensure that existing systems maintain their access security for the local environment while they are interconnected to the central or regional center. Provisions for the networking environment must include local, regional, and/or centralized management and control of the ACC via the network infrastructure.

Prioritization of traffic, preferably developed from an operational analysis prepared during the CONOPS, must be designed into the proposed network infrastructure.

Mission-critical traffic should be identified and afforded the highest level of availability, redundancy, and resiliency in network resources. The ACC availability goal in a shared IT network environment should be at least 99.9%. For most ACC applications, this will require IT network availability of 99.99% or higher, depending on the network architecture and the network resources required to support the ACC. When this level of network availability is not possible, the ACC design should focus on ways of attaining close to zero downtime for critical security functions, including information flow to incident responders.

Average, minimum, and maximum response time goals, to be determined during the requirements process, must be maintained throughout the operations period of the network, including periods of moves, adds, and changes which affect database records.

The network should be sized to have enough excess operating capacity to maintain the initial operating traffic parameters (to be determined) and accommodate sustained peak loads during download/upload of information without effect on operational response times. In addition, there must be reserved capacity for traffic reroutes during the failure of an interconnecting node within the network.

Priority reserved capacity (outside of the excess capacity for peak operations) is required for emergencies to allow multiple locations to be accessed from a central command center to coordinate database lookup and updates. When services are provided by common carriers, such as telephone service, arrangements should be made for priority access during emergencies, particularly for cellular services.

Access to a WAN by a commercial telecommunications and network service provider should include both guaranteed minimum bandwidth and guaranteed surge bandwidth. The guarantees of bandwidth should be set forth in a written Service Level Agreement (SLA) with the service provider to ensure sufficient bandwidth, network availability, and a secure data transfer.

7.7.6 Bandwidth Management Issues

When airport video surveillance systems are networked, special design consideration must be given to such issues as transmission bandwidth over the network, network headroom allowances, and video storage (including imagery resolution and frame rate, storage duration, and permissions for accessing and viewing stored imagery). Network architecture may involve both centralized and edge-based assets.

Determining the bandwidth requirements for the ACC is essential in technology planning during the design phase. CCTV is a heavy user of bandwidth—today's CCTV systems support hi-definition visual images at frames-per-second speeds, which generate large files. These images can seriously affect network throughput if the network architecture has not been designed properly. An equally critical aspect of CCTV image size relates to the amount of storage needed to maintain images to meet airport, local, and state requirements for data retention. Most large CCTV systems require petabytes of storage—often exceeding the amount of storage needed for all other airport systems.

7.7.7 Mobility

Remote or mobile communications technology should be part of the integrated command center concept. Incidents often happen in the absence of key personnel, during holidays, late at night, or when a person with critical skills is on vacation. During an incident, key personnel may not be able to respond to the emergency command center. When response time is critical for reducing risk or preventing an incident from becoming a major disruption, remote communications can provide access by key decisionmakers.

7.8 Workstation Design

Section 5.7 of this Guidebook discussed the ergonomic and furniture requirements of functional workstations. This section provides further recommendations on the most appropriate ACC configurations.

The workstation is the most important aspect of ACC design and special care must be given its layout. ACC personnel are likely to be seated at a workstation for most of their working hours, and comfort and utility are critical to ensuring that personnel can focus on the subject matter, rather than their surroundings. Recommendations for the workstation configuration follow.

7.8.1 Proper Work Surface Setup

- The work surface should be installed/adjusted to be approximately 25″ to 34″ high for seated work and to fit a range of operator sizes (ensure that adjustments can be made easily).
- The space beneath the work surface should have sufficient room above the legs to allow for a range of body postures. The knee well should be at least 30″ wide by 19″ deep.
- The work surface should have adequate space for equipment (e.g., monitor, telephone, stapler, and tape dispenser) to be close to the user so as to minimize bending, flexing, or twisting of arms, wrists, or hands.
- A matte finish on the work surface is ideal to reduce light reflection.
- The keyboard and mouse should be placed together on a platform at least 28″ wide, directly in front of the user and directly beneath the monitor.
- The keyboard and mouse platform should move easily (i.e., side to side, up and down, and in and out) and lock securely in place.
- The height of the keyboard/mouse platform should allow the user's hands to rest lightly on the keyboard and mouse with forearms using the chair armrests for support.

7.8.2 Keyboard & Mouse Adjustments

- The keyboard height should allow straight wrists and a 90-degree angle between the upper arm and the forearm (angle should adjust by 20 degrees up or down for individual preference and periodic adjustment).
- The keyboard height and angle should be adjustable (reverse slope).
- The keyboard and mouse should have a wrist rest and/or mouse rest available for support when taking mini-breaks.
- The standard keyboard should be replaced with an alternative keyboard (split-key) and alternative mouse (trackball or touchpad) if personnel develop musculoskeletal disorders.
- The keyboard should be able to support "short-cut software" (macros).

7.8.3 Peripheral Items

- Peripheral items that are used most frequently should be placed closest to the user so that these items can be conveniently and comfortably reached.
- In-line document holders should be used and should sit between the keyboard/keyboard tray and screen and be aligned with users' body midlines so that operators can look down to see documents and raise their eyes to see their screens.
- Screen-mounted document holders should be used. Each holder should be positioned to the same side of the screen as the dominant eye of the user.
- Freestanding document holders should be used. Each holder should be positioned next to the side of the screen and angled slightly so that it follows a curve from the side of the screen.
- To reduce the stress in an operator's neck, a headset may help reduce stretching and improperly holding of the phone.
- Materials should be stored in accessible areas (between 15″ and 48″ above floor).
- Storage areas should allow 30″ × 48″ clear maneuvering space and accommodate right or left-hand access.
- Deep storage should have "lazy susan" carousels and pull-out shelves or drawers with full-extension ball-bearing slides.
- Stored materials should have labels facing out with instructions, symbols, or color coding.
- It may also be beneficial for each user to have their own keyboard and mouse to prevent the spread of germs in shared workstations. At the least, cleansing wipes should be available.

7.9 Managing ACC Video Output

There are many ways to display information in an ACC, and all available options should be evaluated for the particular requirements of the ACC during the design phase of the project. Depending on the physical size and layout, the ACC may have a video wall, separate video display screens arrayed throughout the facility, video monitors on each workstation (in some cases multiple monitors), or, more likely, some combination of all three. How best to position monitors depends on ACC functions, personnel, and the organizations represented within the ACC.

7.9.1 Workstation Monitors

A detailed evaluation of the configuration of operator workstations is essential in designing the ACC. The final configuration will vary depending on the functions assigned to each station, as well as displays for groups within the ACC who perform supervisory functions or who are present as third-party participants or as observers.

A typical operator workstation will have multiple monitors capable of displaying information based on schedules of permissions. At least two monitors should be provided—one for the display of real-time information and one for event or incident assessment. When several cameras are to be monitored, a third display will enable an operator to access cameras from a schedule and/or to monitor event and incident logs. Regardless of the display selection, all monitors should be equally capable of fulfilling all assigned functions to provide redundancy.

Choose monitors with appropriate resolution, dot pitch, brightness, and contrast to reduce eye strain and increase comprehension. Carefully consider the design of large-format visual displays, such as multi-panel video walls, including sightlines from operator stations, lighting, and screen resolution and flicker. Designing for large-format displays requires a cross-disciplinary approach that includes an understanding of technology and ergonomics as well as traditional architectural/engineering concepts. Video wall panels should be individually addressable so that multiple feeds can be displayed simultaneously, including streaming video.

The following factors are relevant to selecting the number, placement, and quality of monitors:

- **Size.** The cost for large flat panel monitors has dropped dramatically in recent years, allowing ACCs to provide larger and higher quality monitors. Consider investing in large units that will help reduce eye strain and provide greater detail when viewing video.
- **Number of screens.** Place primary work screens directly in front of users, with secondary screens to the sides. If possible, use dedicated screens for primary systems, which allows operators to use secondary applications (e.g., email and word processors) while keeping primary systems displayed.
- **Image quality.** Size is not the only attribute that makes a monitor easy to view. An ACC should have monitors with above-average dot pitch (smaller is better), brightness, and contrast ratio of monitors. These characteristics affect image quality, reduce eye strain, and make details appear more pronounced when viewing video surveillance feeds.
- **Viewing angle.** According to the Human Factors and Ergonomics Society ANSI/HFES 100-20073, the center of the visual display screen should be 15 to 25 degrees below horizontal eye level. During work periods, display screens should not be more than 35 degrees off axis (i.e., from the user's predominant line of sight) while the user is gazing straight ahead. Also, the entire visual area of a visual display terminal workstation, including items other than the display (such as the keyboard), should be between 0 degrees (horizontal eye height) and 60 degrees below eye height.

7.9.2 Video Walls

Although some ACCs may choose to use large wall-mounted displays, the trend is to use a video wall. A video wall consists of multiple panels arranged according to the dimensions of the ACC and associated viewing distances. Available monitor technologies include liquid crystal display (LCD) panels, LED arrays, digital light processing (DLP) tiles, and rear-projection displays. Each technology has advantages and disadvantages (related to panel size, resolution, brightness, contrast, flicker, glare, power consumption, reliability and maintenance, and life cycle cost). Video wall configurations typically begin with 2-ft-vertical by 3-ft-horizontal monitors and can expand to many times these numbers, subject to wall area, power and cooling, aesthetics, and budgetary constraints.

Video walls provide a degree of flexibility that cannot be achieved with individual monitors, provided that such flexibility is included in their design. For example, each panel or segment could be individually addressable, from any operator workstation, to permit one event to be stitched across the entire video wall, or multiple events to be displayed on individual panels simultaneously.

7.9.3 Display Options

The selection of a display format is driven by the application. A 4:3 aspect ratio display will generally show more area in the vertical dimension than a 16:9 aspect ratio display. An indoor application, such as hallway monitoring, may benefit from a 4:3 display. An outdoor area, where horizontal coverage may drive the application, might benefit from a 16:9 display.

The term "display resolution" is usually understood to mean pixel dimensions (i.e., the number of pixels in each dimension). This is not the same as pixel density (i.e., the number of pixels per unit distance or area), which is a proper indication of display resolution. In digital video, display resolution is generally given in pixels per inch. In analog video, if the screen is 10 inches high, then the horizontal resolution is measured across a square 10 inches wide and is expressed as lines per picture height (e.g., NTSC TVs can typically display 486 lines of "per picture height" horizontal resolution, which is equivalent to 648 total lines of actual picture information from left edge to right edge).

Considerations related to large-format video displays include the following:

- Large-format video displays are invaluable in communicating information to a large group of people quickly and effectively. Rather than needing to get attention by making an announcement in the ACC, messages, images, documents, and video can easily be distributed to the group by using large-format video displays. This allows effective communication without disruption of disparate activities.
- ACCs are increasingly using large video walls composed of multiple display units arranged as a single display. The question of using LCD screens vs. video cubes when building a video wall has a large effect on cost and visual accuracy. With the drop in cost of LCD screens in recent years, it is sometimes compelling to use them to reduce costs, but their drawbacks may make them unacceptable in mission-critical video walls. LCD screens have a border (also known as a bezel) around each screen. When multiple LCDs are tiled together to form a single large display, the bezels present issues. The bezels are a "dead space" in the wall and cause issues when displaying an image that spans multiple screens.
- Video cubes provide a near-seamless video wall (with tiny borders as small as 1 mm) and can be serviced in place by replacing parts. LCDs, by contrast, are rarely serviceable in place and ordinarily need to be removed and either replaced or sent for servicing, either of which considerably disturb activities in the ACC for lengthy periods. Video cubes offer the highest possible quality and are the preferred choice if the budget permits.

- Whether the ACC has a video wall or LCDs scattered around the space, the ACC will need a control system to feed imagery to the displays. Ideally, the video control system will be able to display video from various sources, including
  – Video feeds from the video management system. The video wall should be able to display video feeds, both live and recorded.
  – Video from television feeds. News and other information from broadcast, cable, and satellite television is often crucial for achieving situational awareness of remote situations.
  – Documents. Staff should be able to share documents electronically instead of printing them.
  – Computer screens. Staff should be able to share views of software applications.
- Determining where a large-format video display should be located is not as simple as finding empty wall space. It is crucial to understand sight lines, refraction, light levels, and acoustic attributes (e.g., sound transmission and ambient noise management). For example, placing a display in the wrong location could result in glare and reflection from windows or inability for some staff to see details on the screen.
- Traditional design techniques, such as floor plans, elevations, and sketched renderings, have proven ineffective in understanding all of these aspects, thus requiring the use of more advanced techniques like 3D digital modeling and full-scale mockups/simulations to assess the effect of display placement adequately.

7.10 External Communications

The ACC will have direct connections to various systems external to the airport. These vital communication links provide critical information to airport management and the ACC. These links are likely to flow into the ACC through the Internet, so the ACC needs a strong, redundant Internet connection. If the ACC is relying on the existing airport connection, airport management must ensure that the existing connection will meet the needs of the ACC, both during regular operations and emergency situations.

7.10.1 Internet Access and the World Wide Web

Broadband Internet access to the World Wide Web and email is vital for ACC participants, especially during emergencies, for communicating with external agencies when traditional wire or radio links are unavailable. Internet access will be essential for participants in the EOC, who in many instances will be representing other agencies in remote locations and will need to access their home networks. The Internet is a massively redundant network and proved its worth during the events of September 11, 2001, and during major hurricanes, tornadoes, and other weather phenomena in recent years.

There are several ways to provide Internet service in the ACC. The ACC is expected to be a node on the airport IT network and network routers can be provisioned for accessing the Internet. It is also possible to connect the ACC to the Internet independently of the airport IT network.

Internet security and network protection are major concerns. Both local and remote access will be involved for non-airport persons participating in the ACC.

7.10.2 News/Weather Feeds

Satellite and CATV cable feeds should be provided to allow news and weather TV channels to be displayed on the wall display monitors in the ACC and the EOC. Each console position will be able to listen to selected audio on their headsets. If satellite and/or cable feeds are provided, the potential to include broadband access (at least on the cable feed), which would be routed differently from the telephone lines into the ACC, should be examined.

7.10.3 Interoperability

ACC links to other agencies may involve local, regional, and state assets (e.g., EOCs, police and fire, and fusion centers) as well as federal agencies (e.g., TSA, CBP, and FEMA) with whom interoperable communications will be necessary. The extent of voice, data, and video streaming interfacing will vary with each organization. Typically, wired and wireless modes of communications will be involved, including trunked radio systems for regional interoperability. Some of these modes may be secured by encryption.

7.10.4 Social Media and Social Network Monitoring

Technology can be used to track smart phone locations at an airport and, via each phone's unique address, to analyze social media messages in real time. Airport use cases include assessing traveler satisfaction and providing retail alerts that may be relevant to travelers based on their social media messages.

7.11 Organizations Operating in the ACC

Although any airport organization may be located in the ACC, the most common are public safety, airport operations (including landside and terminals), facilities management, and the IT department. Each of these entities will have special technology considerations if included in the ACC organization.

7.11.1 Public Safety Operations

Some ACCs double as Security Operations Centers (SOCs). The configuration and functionality of the SOC will depend on (1) how its roles and relationship with responder dispatch and incident management functions are defined in the CONOPS, and (2) how the SOC is staffed and trained to perform these functions. At many airports, and particularly when incident response is primarily the duty of municipal or county police departments, dispatch and incident management may be performed in a separate Police Dispatch Center. Either arrangement is workable with the proper information flow, but proper information flow should be a primary objective of the SOC system design. Figure 7-3 depicts the interrelationships between an SOC and critical security functions, such as identity management, access control, intrusion detection, and video surveillance.

The SOC general design considerations include sufficient space and support facilities for personnel and IT equipment to facilitate rapid access and dispatch to all physical points of the property. Secondary, or backup, SOC facilities may only require mission-critical capabilities and need not be configured with video walls and other full-service equipment. Additional services generally associated with public safety and first response (e.g., first aid stations, lost-and-found departments, public announcement [PA] systems, and paging services) are often supported via public access facilities.

When an ACC includes an airport Police or security operation (e.g., a SOC or a PSAP), a CAD system will often be necessary. The CAD assists operators in responding to an incident and dispatching the correct resources to its location, especially when the volume of activity can easily overwhelm even the best operators. An event that occurs anywhere on the airport will cause

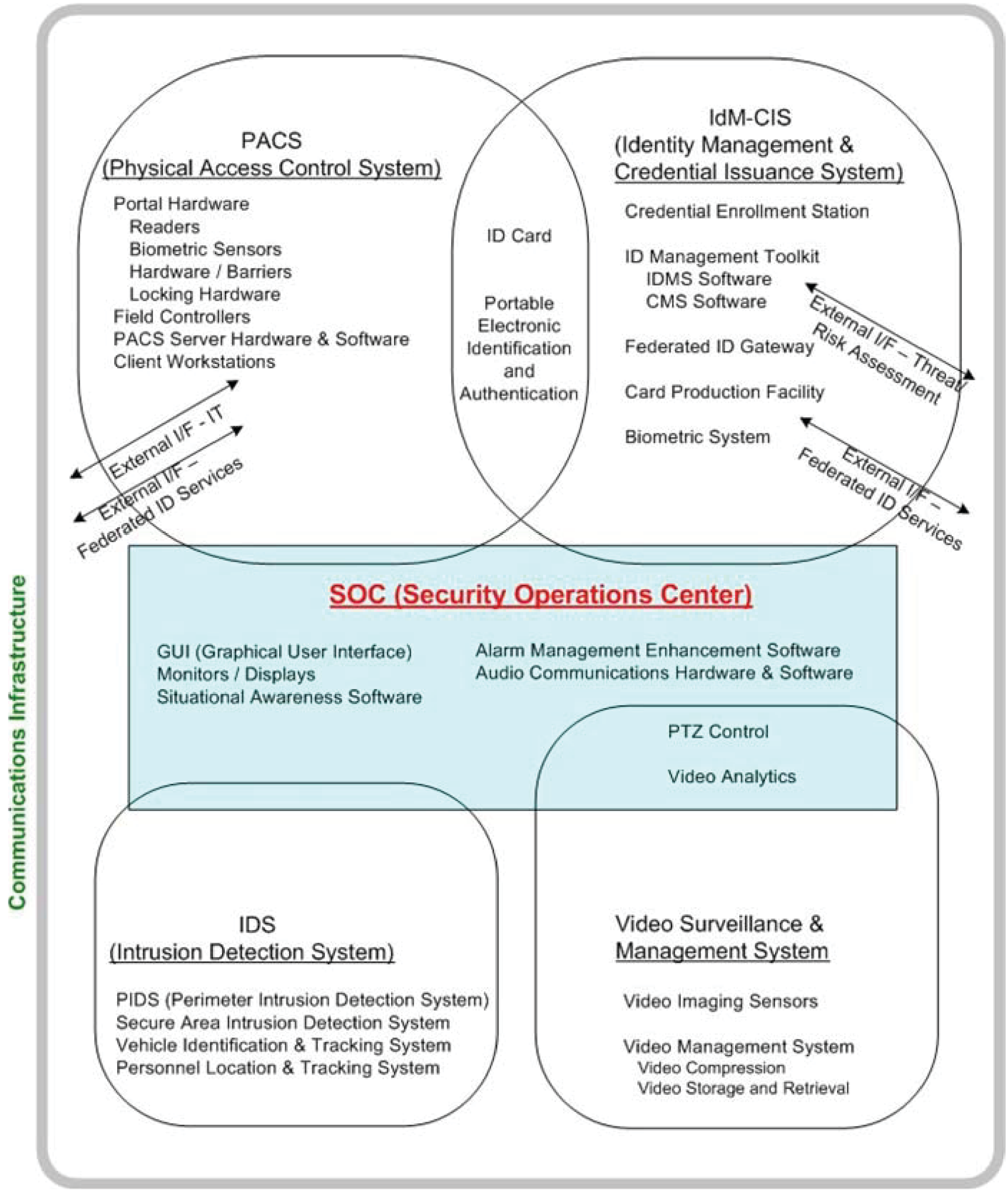

Figure 7-3. Integrated communications for airport security system.

some form of notification to a call taker and/or dispatcher. This notification may be a telephone call via 911 from any telephone on the airport, from the security system indicating a perimeter breach, a fire alarm from any building on airport, or from airport operations.

The CAD system should be designed to provide prompt transaction response time, so that even during times of maximum load on the system there will be no user-discernible degradation of response time or the system's ability to process data. The CAD system should also provide online, real-time support to enhance the operational environment for the police, fire, and EMS services. Operator interfaces should allow dispatchers to access remote data and systems (even when they are on separate systems located at the airport or at another state or federal location) and should support VCIN, NCIC, E911, voice radio, mapping, CCTV, videocamera and digital video recording systems, access control systems, and entry and fire alarm systems.

CAD workstations should support the following operational functions:

- Call Taker
- Police Dispatch
- Fire Dispatch
- Supervisory Functions
- Fire Supervisor
- Police Station
- Fire Station
- System Manager

7.11.2 Airport Operations

Airport operations may be conducted directly from the ACC. Operations and communications have a natural nexus and airports may find that their ACC will take on far more than simply communications and will eventually be the central management point for the entire airport. This is especially important when the airport is either totally or partially common use.

Airport managers and airline tenants are constantly searching for ways to improve the efficiency of their operations and the services they deliver to customers. Airport operators focus on adding flights (and airlines) and maximizing the use of their facilities. For terminal facilities, the metrics are passengers per gate per day (i.e., utilization) and revenue per gate per day. The concept of the common use facilities that has evolved to satisfy these metrics is described in detail in *ACRP Synthesis 8: Common Use Facilities and Equipment at Airports* (2008).

Common use facilities may include

- Passenger paging systems—both audible and visual.
- Multi-user flight information display systems (MUFIDS).
- Multi-user baggage information display systems (MUBIDS).
- Gate management systems (GMS), including common use terminal equipment (CUTE).
- Ticket counters, including common use self-service (CUSS) kiosks.
- Local departure control systems (LDCS).
- Airport operational database (AODB) systems.
- Common use baggage sorting systems.
- Baggage reconciliation systems, including the use of radio-frequency ID (RFID) devices.

This list is not exhaustive, but it demonstrates the effect that technology has on implementing airport common use policies and programs and the challenges introduced when each tenant may have different non-standard legacy systems and unique data requirements.

Airports that operate preferential or exclusive use gates may also benefit from placing airport operations in the ACC, though interaction with the airline will be far less routine.

7.11.3 Facilities Management

Facilities management/maintenance is a likely candidate for inclusion in an ACC because so much of the daily activity in an airport is either conducted by the facility group or their actions affect other airport operations. ACC information gathering is often incomplete if the data provided from this airport organization is not included.

The most likely facility management function for inclusion in an ACC is the maintenance call center. Using the ACC as a one-stop call center for maintenance issues, IT concerns, general public inquiries, and so forth provides valuable insight into and situational awareness of the airport's most important activities. The maintenance call center will likely feed the information received via calls into a CMMS and, as a result, provides the ACC with valuable information on airport issues, activities, potential bottlenecks, complaints, and so forth.

7.11.4 IT Organization

Locating some elements of the IT department in the ACC is prudent and potentially prescient, especially in case of a major emergency. IT services can range from simple desktop support (if the ACC is large enough to warrant dedicated staff) to placement of a network operations center (NOC) or an information security operations center (ISOC).

If simple desktop support is provided, help desk technicians/desktop support should understand that ACC calls take priority and need to be handled immediately whenever possible. Additionally, helpdesk technicians should report immediately to the ACC in any emergency situation. A small cache of emergency IT supplies (e.g., replacement PCs, boards, drives, cables, keyboards, pointing devices (mice), monitors and a printer) should be located near IT helpdesk personnel. It may be useful to have additional VoIP handsets and headsets available. An airport is most vulnerable to an IT failure during an irregular operation or an emergency—when additional stress or unanticipated usage is put on communications technology, a critical failure is more likely. Having IT personnel available during these situations may make the difference between a minute of downtime and several hours.

A more extensive involvement of the IT department in the ACC is having the airport's NOC or SOC physically housed in the ACC. At first, the concept may seem foreign to most airport managers, but almost every aspect of airport operations relies on the IT infrastructure. Having an understanding of network or IT security issues as they are happening is important to having total situational awareness at an airport. Moreover, as cybersecurity incidences continue to increase in all sectors, including the air transport industry, it is prudent to consider how an airport operator will handle such an incident. There are many parallels between handling a physical security incident and a cybersecurity incident and the airport operator needs to be aware of those areas where the similarities can facilitate response. (Further discussion on cybersecurity is provided later in this Guidebook.)

A NOC (also known as a network management center) is one or more locations from which network monitoring and control, or network management, is exercised over a LAN. NOCs can be a simple workstation for small networks or extensive monitoring locations for more complex networks. So as to avoid degraded service, NOC personnel monitor the airport's networks for conditions that may require special attention. Having a NOC in an ACC can enhance situational awareness and response to network or system outages.

In addition to monitoring internal and external networks, NOCs can monitor social networks to get an early awareness of disruptive events. Like an ACC, large NOCs are designed with several rows of desks facing a video wall that shows details of general network performance, alarms, and outages. If airport management decides to include a NOC in its ACC, the NOC could double as the ACC's data center and telecommunications facility.

An ISOC is a dedicated site where enterprise information systems (e.g., websites, applications, databases, data centers and servers, networks, desktops, and other endpoints) are monitored, assessed, and defended.

A help desk is a resource intended to provide the customer or end user with information and support related to an airport's products and services, usually by troubleshooting problems and providing guidance about desktop computers, airport applications, phone issues, and mobile devices. The IT help desk can be located in an ACC. Given that IT issues often are first discovered through help desk calls or inquiries, having that information resident in the ACC could enhance airport situational awareness.

7.12 Situational Awareness Software

Situational awareness involves understanding the relationships of events and information relative to an airport's point of view in both time and space. In an emergency, data develops in real time, and data that is not available when a decision needs to be made is not of any use at all.

An airport operator may want to consider situational awareness software that can continually monitor multiple events and coordinate, categorize, assess, track, prioritize, and assign appropriate response resources while simultaneously reviewing developing events for relevant patterns, trends, and correlations so that any resulting information can be consistently modified to support regulatory requirements and forensic analysis. The resulting analysis can be used to guide adjustments in policies and procedures. Selecting sensor systems with standard interface protocols will enable evolving predictive algorithms to be deployed to assist operators in preventing incidents. In seeking to attain situational awareness, remember that detection is not meaningful without assessment; assessment is not meaningful without response; and response is not meaningful without resolution. Ultimately, prevention is the desired goal, which may be achieved at any point during the awareness cycle.

The ACC should facilitate an optimal level of situational awareness. ACC design must balance operational processes and procedures, technological capabilities, budget and space limitations, regulatory guidelines, and other considerations into a cohesive utility that can include command and control functions for activities in various operations centers (e.g., AOCs, EOCs, and ICPs).

Even for small airports, operators who are removed from the scene in an ACC may have difficulty quickly understanding where an event is happening—this is true for several reasons. One reason is that multiple systems often have different naming conventions. Few airports have implemented all their technology at one time—Many airports have technologies from multiple eras, implemented over decades. One effect of this multi-generation implementation is that locations, alarms, and other assets can have different names in different systems. Another challenge is that being able to mentally correlate information and visualize it in a geospatial context varies widely from person to person.

To address these challenges, many ACCs use technology to correlate information from multiple systems to create a single "incident package" of data that is normalized for the alarm. For example, since the 1990s, O'Hare International Airport has combined alarms with maps and video feeds to provide ACC operators with a clear picture of the location and the incident. By combining these resources into an information-rich incident package, operators have the best possible view of the event, which helps them assess what is happening and respond faster and more effectively.

7.13 System Test, Verification, and Validation

The ACC should be considered as a system and all best practices for system design, acquisition, development, and implementation should be followed. One of the most critical aspects of the system lifecycle is proper testing before the ACC goes "live." ACC testing activities may take various forms and include system test plan development, system test procedure development, system qualification testing (SQT) and/or factory acceptance testing (FAT), site installation testing (SIT), and operational testing (OT).

ACC acquisition and installation should include a system test plan that should describe the approach to verifying all system requirements, including the test scenarios to be executed. ACC testing should

- Ensure that the new ACC meets specified operational and functional needs and capabilities, and
- Verify that the ACC is operationally ready to be handed over to and operated by the users.

An overall system test method should include the following steps:

- Determine the overall goal(s) of the test, including the device(s) to be evaluated and the test location(s).
- Identify the operational, functional, environmental, and measurable parameters that need to be evaluated to define the success or failure of the devices.
- Prepare, for the user's approval, a test plan that sets forth measurable parameters for scenarios of operational conditions and that scales the testing according to the available resources and time. The operational conditions to be tested should include
  - Conditions representing the normal range of operating parameters,
  - Abnormal conditions, and
  - Deliberate attempts to fool and/or defeat the system.
- Develop a baseline of relevant operational and functional data on existing test site(s) prior to the installation of new device(s).
- Install the new device(s), verify their continuity and, if appropriate, include their network connectivity, and verify that all devices are set in the appropriate mode and are to be operated in the appropriate conditions for testing.
- Conduct the tests in accordance with the approved test plan.
- Analyze the results, particularly with respect to the baseline data and to the specified performance and functional requirements, across the range of test conditions.

7.14 Technology Security

Securing the technology used in the ACC is of critical importance. As the airport operator becomes more reliant on the ACC, the corresponding systems that provide the ACC with data become more important. These systems' continued confidentiality, integrity, and availability (the CIA triad often cited in cybersecurity discussions) is of paramount importance and every step necessary to ensure the successful operation of the systems and applications should be taken. There are some basic steps an airport operator can take to help ensure the highest level of security possible. Section 8.7 of this Guidebook discusses creating a Facility Security Plan focused on the security of the ACC's physical presence. A similar approach to system and application security is also highly recommended. Even for small and medium-sized airports, security begins with security governance. As either a component of the Facility Security Plan or as a standalone initiative, ensuring proper security controls is an essential element in system security.

The intent of security governance is to guarantee that the appropriate information security activities are being performed to ensure that risks are appropriately reduced, system security investments are appropriately directed, and airport management has visibility into the security program. (Technology security will likely be part of a larger airport technology security effort so this Guidebook primarily touches on those elements related directly to an ACC and provide a few best practices.)

For both physical and cybersecurity, IT security governance begins with a risk assessment where threats, vulnerabilities, effects, likelihood, and mitigation efforts are considered and documented. Without a thorough risk assessment, applying security measures is often ineffective and misplaced. Once the risk assessment is completed, the ACC, or the airport, will have carried out its due diligence and due care in providing for technology security.

7.14.1 Physical Security

The physical security for ACC systems and applications should already be in place; however, the following points should be considered while the ACC is being planned and designed:

- The data center and telecommunications rooms where ACC systems and applications reside must be protected. These areas must be physically secure with limited access and in environmentally conducive settings.
- There should be a plan for replacing hardware before it fails so that disruption of availability is reduced as much as possible.
- External third parties should have limited access to airport hardware and software resources and, where appropriate, such resources should be tightly controlled.
- Camera equipment, access control mechanisms, radio antennas, and other data gathering endpoints must be maintained, protected, and upgraded as necessary.

7.14.2 Cybersecurity

Because of the computer-based architecture of today's security systems and the interconnected nature of the Web-based world, all systems must be secured against cyber threats. Cybersecurity is far too complex to cover in detail in this document; however, ACC facility designers should create a plan for cybersecurity that addresses design challenges such as firewalls, virus detection, intrusion detection, and identity management. A trusted outside organization or another airport team should test the cyber defenses established by the airport security team. A major flaw in testing your own network security is a tendency to limit the test to the new systems and not consider other major vulnerabilities.

The extent of threats to communication systems is illustrated by techniques exploited by the Stuxnet attack on the SCADA systems that controlled some nuclear centrifuges in the Middle East. The attacking software used multidisciplinary exploitation techniques to achieve a specific result on a particular target. By their nature, ACCs communicate with numerous external systems, each of which may be exposed to different cyber threats, so cyber threats can come from multiple sources.

Modern operating systems contain some countermeasures for cyber threats running at elevated privilege levels, including requiring that digital signatures on software must be checked before the software is loaded for execution. Cyber-attack authors subvert this countermeasure by obtaining (most likely through physical exploitation) digital certificates that contain valid credentials used to sign software that can then be loaded onto the operating system.

Making the necessary information available to the appropriate people—and only to those people—involves cultural, technological, and operational changes in a dynamic environment. Airports should recognize that such an approach is likely to challenge some cultural barriers to trust and data sharing within an organization. NIST's *Special Publication SP 800-37*, "Guide for Applying the Risk Management Framework to Federal Information Systems," addresses changing risk identification and system certification from a static, procedural activity to a more dynamic activity that promotes effective management of information security risks in the face of increasingly complex threats, vulnerabilities, and mission objectives.

7.14.3 Cybersecurity Vulnerabilities

Common cyber threats include

- Authorized individuals failing to log off or re-secure their access points or computers, making undetectable unauthorized access available by others.
- Authorized individuals gaining access to portions of the network they are not authorized to access.
- Unauthorized individuals gaining access to the network from computers or systems that normally allow access only to authorized individuals, either by "hacking" or by using an authorized individual's passwords or access codes (which, in turn, suggests a need for stronger password protocols).
- Unauthorized individuals gaining access to the network from computers or systems on premises or in restricted areas that normally do not allow access.
- Unauthorized individuals gaining access through external connections such as Wi-Fi modems or wire-taps.
- Cat-5 access ports available for local use that are not disconnected when authorized use is concluded, thus exposing the network to external access.

Similar to physical security, network/data/information security is based on understanding these and other vulnerabilities and agreeing which of them can be mitigated. Regardless of what the threats are, there are at least three levels of control:

- Administrative Control. The security system applications and network should support the airport's own security standards, policies, and procedures, including password policies.
- Logical Control. Use software and data (e.g., passwords, network- and host-based firewalls, network intrusion systems, access control lists, and data encryption techniques) to monitor and control access to information and computing systems.
- Physical Control. Monitor and control the telecommunications rooms where equipment and infrastructure are located. Use access control systems to secure areas critical to the airport network. Use of metal keys to access telecom rooms does not (1) offer accountability of who entered or when, (2) track key assignments, or (3) validate the person's permissions.

Although there is significant flexibility in selecting requirements from the NIST SP 800-53 Security Catalog, IT technology makes it challenging to select suitable measures and implement them cost-effectively in a way that is also compatible with staff resources and skills. For example, netcentric architectures (e.g., user-oriented architectures and cloud computing) can introduce subsystems that may not be part of the larger system throughout all stages of the life cycle. Including a subsystem may require reassessment of the security risks to an airport's IT network using the designated controls—this is a continuing process driven by the need to cope with evolving threats.

7.15 Privacy and Other Legal Considerations

Some elements of the ACC, such as video surveillance and the massive amount of data that it generates, raise legal considerations that affect system planning, design, and operational use patterns. From the placement of cameras, to the safeguarding and retention of the data collected, to the access, use, and dissemination of that data, security system planners and designers must satisfy requirements imposed by federal, state, and local laws. These requirements can vary significantly by jurisdiction, so airport counsel perform a legal review of the planned systems.

Legal considerations generally address the following questions:

- What information can be collected?
- Who has access to data once it is collected and how is the data being shared/used?

7.15.1 Data Collection

The principal concern is privacy protection. As a general rule, under both federal and state law (although some state privacy protection law is becoming more restrictive), there is little or no protection against observation of conduct that occurs in a public place. For surveillance systems configured for surveillance of only public areas, it is unlikely there will be any significant legal concerns.

Where surveillance systems are in areas that adjoin private areas (e.g., private property adjoining an airport perimeter) or near public areas where there is some expectation of privacy (e.g., in a terminal concourse near a restroom), efforts should be made to restrict the ability of CCTV operators to observe those areas by means such as restrictions on video camera coverage or using software that blocks the views of concern.

7.15.2 Data Storage and Use

Data storage and use of data issues that might affect ACC planning and design include privacy protections; records retention requirements; Freedom of Information Act (FOIA) requirements; and Sensitive Security Information (SSI) regulations:

- **Privacy Protection.** A growing body of law suggests that data compilations may have unique requirements for protection for which systems are necessary to ensure that data is safeguarded and only used for appropriate purposes. ACC design should provide for the control of internal permissions and authorizations for access to data and permission for activities such as copying and disseminating data.
- **Records Retention.** In most jurisdictions, state and local laws regulate a public body's activities with respect to disposition of public records; some treat surveillance data as constituting a public record required to be retained in accordance with an established schedule. Therefore legal retention requirements for video data may be substantially longer (or shorter) than called for in the airport's CONOPS. Planners and designers should be mindful that retention requirements can be changed by the external body setting the retention schedule, so system design and storage requirements may have to be modified to accommodate such change.

- **FOIA Requirements.** As with record retention requirements, FOIA requirements may be imposed through state and local laws that require the airport operator to make certain data that is not governed by exemptions accessible. The existence of FOIA provisions has implications for system design with respect to what data is recorded and stored, how it can be retrieved, and the length of its retention.
- **SSI Regulations.** TSA regulation of SSI concerning airports under the provisions of 49 CFR 1520 raises significant issues with respect to safeguarding video information. Some, if not all, video data raises potential security concerns, and video systems must be configured to ensure that such data is properly identified and safeguarded. This includes permissions and authorizations with respect to access, use, and dissemination of video data. ACC personnel training should include awareness and handling of SSI issues.

SECTION 8

Operations

The primary mission of an airport staff is to ensure continuous, safe, secure, and efficient operation of everything within the physical boundaries of the airport, including runways, terminals, roadways, support facilities, perimeters, and critical infrastructure. A good working environment is critical to bringing about the clear, direct, and coherent communications necessary to achieve this goal. The function of an ACC (and its personnel) is to collect, record, transmit, log, identify, analyze, and communicate information to facilitate smooth operations. ACC staff must do so through various circumstances and situations, from normal everyday functions to periodic irregular operations, to catastrophes that may occur only a few times in a career.

For ACC personnel, knowledge of the airport's rules, regulations, and standard operating procedures, coupled with a deep understanding of the systemic ability to transmit and receive information effectively through various means, is the key to successful communications. An operational understanding of the language and unique terminology/jargon used by all airport departments is essential to ensure that everyone communicates in a consistent manner. Staff is routinely tasked to pull together systems, equipment, personnel, resources, and material to resolve unusual situations, and to test, drill, and exercise skills so as to be prepared for almost anything. When an operational anomaly occurs, effective communications often makes the difference between a successfully concluded incident and one with a negative effect.

8.1 Management Oversight

A critical element in maintaining the effectiveness of the ACC (once it is implemented) is to ensure that ACC evolves with changes in the airport organization, structure, and mission. Major changes in the airport's operations (e.g., a shift to a fully common use airport or the opening of a new runway or terminal) will seriously affect the ACC. Even the smallest change can affect systems, processes, and procedures, so ACC management must make appropriate modifications to ensure that changing conditions have been properly reflected in all of the ACC's supporting documentation (including the CONOPS, situational awareness templates, policies, and standard operating procedures).

Depending on the structure that the airport director has chosen for ACC management, responsibility for management oversight falls on the shoulders of the ACC manager or a committee of those organizations represented in the ACC. Whatever the management structure, changes must be accurately reflected in a timely and accurate manner consistent with the operational change.

8.2 Standard Operating Procedures (SOPs)

The CONOPS embodies the intended mission and functionality of the ACC. As the number of systems increases and the complexity of the systems grow, it is more important than ever for all ACC personnel to fully understand the CONOPS. The CONOPS provides the operational guidance that dictates how the systems should be used, the information that will be provided, proper maintenance of the system, and how the system will complement their own skills and expertise.

This operational guidance is also outlined in the Airport Certification Manual (ACM), which is required as part of the airport's governmental operating certification under Part 139. The ACM provides a guide for an organized and orderly approach to all operational matters at the airport, as well as a consistent training tool for ACC personnel in all the areas of operational knowledge and situational awareness in which they will be expected to function.

Although each ACM will be unique to its airport, ACMs will address the physical layout and function of all facilities, the terminal and airfield, signals and markings, emergency and security programs, lighting, NAVAIDS, air traffic and meteorological services, and cargo and general aviation, among other topics. Once the entire airport physical and operational environment is documented, the airport must develop SOPs for normal daily activity as well as anomalies and irregular operations that may occur.

The basic outline for the SOPs will be established during the development of the CONOPS, during which stakeholders determined each ACC function, the information needed for that function, the decision-making process, and the parameters available on which to make decisions and achieve the desired outcome. Two sets of operational guidance will evolve as the airport's decision-making process matures. The first will address the larger and broader issue of how management operates the airport; the second will address how to operate the ACC most efficiently and effectively to support the smooth operation of the entire airport. The latter supports the former by demonstrating how all the facets interact and providing the means of communications to facilitate the flow of information among them.

The ACC SOPs are based on the CONOPS. Virtually every function listed in the CONOPS will have at least one (and likely many) corresponding SOPs. The ACC SOP document will consist of step-by-step information on executing specific ACC tasks. The airport operator probably already has a comprehensive document or at least a number of policies and procedures. It may be that the airport's primary goal is to compile all the existing procedures, re-write them in a common format, and publish this as its SOP document.

The three essential steps in the SOP process are developing a format, writing individual SOPs, and reviewing and testing draft SOPs before they are formally issued.

It is important to develop a format standard that is routinely followed. No SOP format is better than any other (Appendix E provides a sample template that an airport can use if it has not already adopted one). If the airport operator wants to create its own template, the following options should be considered:

- A simple step format works well for routine procedures that are short and have few possible outcomes. This type of SOP is really just a bullet list of simple sentences telling ACC personnel exactly what to do (although the SOP should include necessary documentation and safety guidelines). This format is usually used when little or no discretion is allowed.
- A hierarchical step format can be useful for long procedures (i.e., with more than ten steps, involving multiple decisions, clarifications, and terminology). This is usually a list of main steps all with sub-steps in a particular order.
- A flowchart format. If the procedure is particularly complex with multiple possible decisions, a flowchart will likely be necessary.

Three main factors to consider before writing an SOP:

- The terminology used should be consistent with the terminology used in the airport. For example, if the physical access control system has been given a local name, such as ACAMS (access control and monitoring system) rather than the more commonly used PACS (physical access control system), the local name should be used.
- If the SOPs will be used by non-airport personnel, who may not be familiar with airport terms, the SOPs should use little or no jargon.
- If the SOP is used outside of the ACC elsewhere in the airport, ensure that it is consistent with operations in both places.

The SOP should have a specific function in mind, and that function should be reflected clearly in the language used. To achieve this, answer these questions:

- Is there a specific reason why this SOP is necessary?
- Will this SOP be mandated as a strict policy or will there be discretion available to those using it?
- How does it relate to the ACM?
- Does it need to stress safety measures and should it be coordinated with the airport's public safety organization?
- Are there specific compliance measures that govern this SOP, such as Part 139?
- Is it used for training or on a daily basis?

The second step is actually writing the individual SOP. In general, SOPs will consist of the following elements:

- The Title Page, which will include (1) the title of the procedure, (2) an SOP identification number, (3) date of issue or revision, (4) the name of the airport/division/branch the SOP applies to, and (5) the signatures of those who prepared and approved the SOP.
- A Table of Contents, which is only necessary to ensure ease of reference if the SOP is long.
- Authorization. Quality assurance/quality control for each SOP is essential. A through vetting of the SOP is essential if you expect everyone in the organization to follow the requirements. Authorization of the SOP by an authorizing official is critical, as well as the concurrence of any airport department to which the SOP applies, should be included on the SOP.
- References. All cited or significant references must be listed. If other SOPs are referenced, include the full SOP reference information.

For each SOP, at a minimum, address the following:

- **Scope and applicability**. Describe the purpose of the SOP, its limits, and how it is used. Include standards, regulatory requirements, roles and responsibilities, and inputs and outputs.
- **Method and procedures.** List all the steps with necessary details, including references to systems and equipment as needed. Cover sequential procedures and decision factors. Address the "what ifs" and the possible interferences or safety considerations.
- **Clarification of terminology**. Identify acronyms, abbreviations, and all phrases that may not be common for the airport.
- **Public safety considerations**. This should be its own section and relevant items should be provided alongside the steps where such items may be an issue.
- **Equipment and supplies.** Provide a complete list of what is needed and when, where to find equipment, standards of equipment, and so forth.
- **Risk assessment**. Identify potential issues that may affect the successful completion of the SOP. Develop mitigating steps for each possible risk.
- **Writing that is concise and easy to read.** Because an SOP may be referred to in emergency or crisis situations, the SOP should be clear, to the point, and easy to read. Unless great detail is essential, an SOP should be considered a quick reference.

- **Control document notation.** The SOP is one of many SOPs; therefore, each SOP must be accurately cataloged using a taxonomy system similar to the guidance provided in Section 2.1 of this Guidebook. Each page should have a short title or ID #, a revision number, date, and "page # of #" in the upper right-hand corner (for most formats).

The third step is reviewing and testing the draft SOP. Involving personnel in developing the SOP will make it more likely that they will accept the SOP. The review process before the SOP is formally issued is as important as writing the SOP. Every SOP must be thoroughly vetted by management and especially by the staff who will execute the SOP. The SOP must be tested. Ideally, have someone with a limited knowledge or even no knowledge of the process use the SOP to guide them through the steps. Look for inaccuracies, areas that are ambiguous, and especially anything that could affect the safety of the public or airport personnel. It is a best practice to have multiple personnel test the SOP because different individuals will have different issues, thereby ensuring a wider variety of comments.

8.3 Human Resource Management

Managing ACC personnel is a big challenge in the airport environment. Depending on the functionality of the ACC, the size of the staff, the number of systems, and the level of activity in the airport, the stress level of ACC personnel can be high, especially during irregular operations and emergency conditions. Airport management must strive to eliminate unnecessary stress so that personnel can focus on the issues at hand without distraction. This Guidebook presents recommendations for airport management to consider in its efforts to alleviate stress.

8.3.1 Stress Management

Airport management needs to understand that working in the ACC, especially soon after it is established, will increase the stress levels of the personnel. New procedures, new physical working environment, new coworkers, and, especially, new lines of communications will all increase the level of stress in the environment. Furthermore, as the ACC moves into an operational state, some systems will not work exactly as planned and will need to be adjusted and SOPs may have some flaws.

Job stress results from the interaction of the personnel and the conditions of work. Each employee will respond to the new working environment differently. What is stressful for one person may not bother someone else. Airport management must be sensitive that the "one-size-fits-all" approach may not be effective for a highly active ACC.

Conditions that may lead to stress include the following:

- **Poor task design** (e.g., heavy workload, infrequent breaks, long work hours, hectic and/or routine tasks with little inherent meaning)
- **Ineffective management style** (e.g., lack of participation by staff in decision-making, poor communication in the organization, and lack of employee-friendly policies)
- **Poor interpersonal relationships** (e.g., poor social environment and lack of support or help from coworkers and supervisors)
- **Unclear and/or inappropriate work roles** (e.g., conflicting or uncertain job expectations, too much responsibility, too many "hats to wear")
- **Environmental issues** (e.g., unpleasant or dangerous physical conditions, such as crowding, noise, air pollution, or ergonomic conditions)
- **Technology overload.** (e.g., the number of communication systems present—cell phones, email, the Internet, and all of the airport systems that converge in the ACC make it increasingly difficult to focus).

8.3.2 Management Role

Airport management plays an important role in ensuring that the ACC environment is as stress-free as possible by engaging in employee-friendly activities that promote an atmosphere conducive to carrying out the mission of the airport, as well as attending to the needs of the personnel. Examples of employee-friendly policies and approaches include

- Mandated breaks and desk-side exercises. Mandated breaks and desk-side stretching exercises have been shown to reduce strain and fatigue when practiced regularly. Breaks allow the operator to "reboot" mentally, and simple activities like standing, stretching, and bending to touch toes for a few minutes can reinvigorate the body, which also helps to refocus the mind and prevent fatigue.
- Employee recognition activities. Rewards for positive behavior encourage employees to find new approaches to difficult tasks.
- Employee social activities. Social activities help to create a community feeling in the ACC. This is especially important where the ACC is composed of organizations that formerly did not work in the same physical location.
- Developing a sense of community. Use of ACC polo shirts, jackets, hats, and so forth help to convey the ACC's importance in the airport structure.

One of the more effective tools is to create an intra-organizational group within the ACC of employees from each function or organization who can discuss issues and provide recommendations to management. Although typically non-binding, these groups can be used to channel employee concerns into positive results.

8.3.3 Pandemic Planning

Because ACC personnel play a critical role in ongoing airport operations, the ACC must be fully staffed at all times. A pandemic plan should detail how the airport ACC will continue to operate through a sustained period with significant employee absenteeism. The plan should also specify measures for "non-pharmaceutical intervention," which means, essentially, how the airport will minimize the risk of contagion among employees. One of the simplest ways for an airport operator to reduce the spread of contagions is by supplying hand disinfectant and wipes at every workstation in the ACC. It may even be advantageous to allow each employee to have their own keyboards which they can store solely for their use. If the airport has already established a pandemic plan, then the plan simply needs to be modified to include the ACC and any additional provisions for the ACC.

8.4 Staff Training

All ACC personnel should be familiar with and trained on all aspects of the ACC's operations, including the CONOPS, SOPs, and the Facility Security Plan (FSP) (Section 8.7). All airport personnel should receive refresher training in their assigned duties annually. Tabletop exercises are an effective and cost-efficient method of validating the CONOPs, SOPs, and FSP and will help in identifying areas for improvement and soliciting feedback from those who regularly execute these documents. At a minimum, training should be conducted with participation of the ACC and all levels of the airport's security and facility operations.

Additional training should be scheduled whenever there are significant changes to the ACC mission, personnel, or function as identified in the CONOPS. Training of airport staff should be equipment and system specific.

Cross-training should be considered whenever possible, especially in medium and small airports where a single individual has more than one role.

8.5 Facility Operations and Management

Ensuring that the ACC maintains a comfortable working environment is critical. Every aspect of the working conditions—from lighting to temperature control to physical space—must be maintained in the most pleasant condition possible. Typically, the airport's facility management staff will be responsible for the physical nature of the ACC. The following topics should be given special consideration:

Environmental issues that need to be addressed include the following:

- **Temperature and Humidity.** Suitable temperature and humidity are extremely important for human comfort and efficiency and to protect equipment. Temperature control is one of the most impactful aspects for an ACC, because temperature can make operators uncomfortable, thus lowering their information absorption and situational awareness and distracting them from their duties. The number one complaint received by facility management (both in ACCs and in general office space) is that temperatures in the space are too low or too high.

  Temperatures in the ACC need to be controlled effectively, despite the presence of heat-generating equipment that varies in intensity and hours of operation—this can be difficult if the ACC shares HVAC systems and controls with adjacent spaces. Ideally, the ACC will have dedicated HVAC units and controls.

  The latest advance in environmental control in ACCs is the installation of heating and cooling ducts in consoles. This allows each operator to adjust temperatures to their specific requirements. This is the most comfortable system for ACC staff, but it also entails a significant cost and requires a raised floor to allow duct distribution. Although it is possible to run ducting from the ceiling to each console, this introduces a "forest" of ducts that would block sightlines.

  Humidity control is important to staff comfort and to prevent low humidity (which can cause excessive build-up of static electricity that can damage sensitive electronics) and high humidity (which can cause condensation inside equipment).
- **Lighting.** Lighting is an important physical consideration in an ACC. Lighting must be appropriate for both monitoring large-screen displays, perhaps from as far away as across a room, as well as for individual workstations. Enabling each employee to manage the lighting at their own individual workstation is important for ergonomic reasons and for increasing employee satisfaction.

8.5.1 Facility Management

The ACC facility is an important part of the operational structure of most airports and will vary depending on the size and complexity of the airport and the user requirements as developed in the CONOPS. The ACC may combine several different facility operations with somewhat different functions, built on a common integrated infrastructure to leverage multiple communication links throughout the airport. These functions may include police, fire/rescue, airport operations, and mutual-aid assistance—all of which may need secure communication channels to federal, state, and local agencies. These communication links may be used for allocating resources, gathering of information, and/or coordinating action.

Operational space considerations include the following:

In most ACCs, different missions have different profile requirements. Having different functions in the ACC will require consideration of how the functions operate in parallel. The most common functions are

- The AOC, which focuses mainly on daily airport operations. The AOC manages routine daily work, with occasional emergency response activities. AOCs may also include monitoring building functions such as building automation and asset and maintenance management.

- The EOC focuses on managing emergencies. An EOC is generally not occupied until it is "activated" by an incident. Technology infrastructure should be designed to accommodate unfamiliar outside users from multiple organizations and should be scalable for the sudden influx of people when emergencies occur.
- The Security Operations Center (SOC) manages video surveillance, alarms, access control, and other daily security systems. SOCs support routine work and frequent coordination with emergency response activities. SOCs often use large-format video displays for showing multiple video surveillance feeds.
- Public Safety Answering Points (PSAPs) are charged with managing public safety personnel, (e.g., police, fire, and EMS).
- Fusion Centers are designed to support the interaction of multiple organizations in a facility that encourages collaboration. Fusion Centers are typically used by government agencies to collaborate on intelligence issues and exchange knowledge not easily communicated via more formal channels of communication. At an airport, Fusion Centers may not be staffed full time.

When multiple types of operations occupy the same space, there may be advantages during emergencies, allowing easier communications among emergency managers and representatives of other outside groups who have been called in to coordinate multi-jurisdictional response teams. However, there may be a negative effect if dealing with an emergency is allowed to affect normal daily functions. If properly designed, the ACC should be able to accommodate these emergency management functions without disruption. However, once operational, if the ACC experiences difficulties in housing various functions, some architectural changes may be necessary. For example, glass walls and/or doors or movable walls are a simple way to maintain the integrity of each operation, while allowing collaboration when appropriate. Glass walls or doors can also allow visual communications between EOC and AOC/SOC staff and enable sharing of visual resources (e.g., video walls).

8.5.2 System Maintenance Plan

System maintenance (e.g., repair, spare parts, technical support, and maintenance) for the installed ACC will depend on whether the procuring authority or a contractor is responsible. In either case, a system sustainment plan should be developed that describes the approach, including the personnel, equipment, and facility resources required.

8.6 Facility Security

The safety and security of the ACC are of critical importance. As the nerve center of the airport operation, the ACC must be able to operate without interruption in the event of any natural or human-made occurrence. The risk assessment (recommended during the project management phase of the project implementation) should thoroughly cover any potential risk that the ACC could face. Revisit the risk assessment regularly, but at least annually, to ensure that risks are correctly listed and mitigation activities remain relevant to the risk.

An airport should prepare for the unthinkable when planning the security of its ACC. For example, on April 19, 1995, the Alfred P. Murrah Building in Oklahoma City, OK, was destroyed by a massive terrorist attack, killing 168 people. In addition to the tragic loss of life, the regional offices of six federal agencies housed in that building lost the ability to operate for as long as 2 years after the bombing because of the loss of records, systems, documentation, and other operational tools. Although it is hoped that there will never again be an attack of that magnitude on U.S. soil, some of the lessons learned from that tragic day and the measures later prescribed by the federal government for its buildings are relevant to an airport ACC.

Perhaps the most important recommendation is the creation of an FSP. The FSP need not be a large document, but it should provide the necessary guidance to ensure that the ACC is protected. An FSP is a critical component of the airport's overall security program and should be stored in both an electronic format, as well as hard copy for ease of access.

Depending on the airport organization, a unit may already be in place which is responsible for ensuring the physical safety and security of all airport facilities. However, where such a group does not exist, the airport may want to create an ACC Facility Security Committee (FSC) responsible for addressing ACC-specific security issues and approving the implementation of protective measures and practices. It is a best practice for each FSC to have one individual designated to manage the FSC. That person is most likely to come from the airport organization managing the ACC. Alternatively, a designee may be selected by mutual agreement of all ACC organizations. The selected person is responsible to the airport director for any issues regarding the FSP. Different airport organizations (some even external) are responsible for physical security at an ACC. Each of these organizations should be represented on the FSC.

8.6.1 Facility Security Assessment

The FSC is responsible for performing a facility security assessment (FSA) and presenting it to airport management for review and approval. The assessment will include an evaluation of the facility to determine whether the baseline level of protection anticipated for the ACC is adequate or if additional levels of protection are necessary. The assessment will also include a written plan for proposed countermeasures and identify how risks associated with specific, credible threats will be mitigated. This will include developing SOPs for countermeasures where appropriate.

The FSA should also include a technology-specific disaster recovery plan and technology business continuity plan. The airport's Chief Information Officer or IT Director is responsible for the management, implementation, and usability of information and computer technologies and for contributing the technology portion of the FSA.

8.6.2 Development of the FSP

Developing and implementing an effective FSP requires understanding events that could threaten the ACC's personnel, operations, and information. Assessing and categorizing the consequences of these events is the basic function of a risk management process. Once risks to a facility are accurately assessed, the FSC can determine whether countermeasures in place are adequate to address or mitigate those risks or if additional procedural, programmatic, or physical security countermeasures must be implemented.

A step-by-step process to identify key security risks and necessary measures and options to mitigate those risks includes the following:

- Perform a threat assessment. A threat assessment is the process of identifying or evaluating entities, actions, or occurrences (natural or human-made) that possess or indicate the potential to interfere with the ongoing operations of the ACC. A threat assessment considers the full spectrum of threats (e.g., natural, criminal, terrorist, and accidental) for the ACC. Threat data has likely already been developed for the airport as a whole. Special consideration for the ACC must be given using this data.
- Perform an impact assessment. An impact assessment is the process of identifying or evaluating the potential or actual effects of an event, incident, or occurrence on the ACC's functionality. The results of the impact assessment can also be used to prioritize resources.
- Perform a vulnerability assessment. A vulnerability assessment is the process of identifying physical features or operational attributes that may render the ACC susceptible or exposed to identified threats.

- Perform a risk assessment. A risk assessment is the process of collecting information and assigning values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing airport management. A simple approach is to define risk with descriptions ranging from Level I (Low Risk) to Level V (Very High Risk).

8.6.3 Security Countermeasures

Security countermeasures identify and describe in detail all current and planned security countermeasures (including floor plans when available) to address all identified threats. A testing schedule performed by the airport security team and an SOP for responding to security incidents and emergencies are necessary.

8.7 ACC Backup Site

In the event of a catastrophic occurrence that disables the primary ACC site, airport management should have a business continuity plan in place that enables the ACC to continue operating in an alternate site until the primary ACC has been restored to working condition. For planning, an ACC can be considered in the same manner as a data center and many of the main concepts in data center redundancy planning can be followed. The backup ACC site decision will affect the airport's ability to communicate in adverse scenarios. Factors to consider include the following:

1. **Hot, Warm, or Cold Site.** Using terminology typically found in data center backup site selection, an airport needs to decide what level of readiness to seek to maintain, with cost being the primary determining factor. When doing a risk assessment, an airport operator must decide on the likelihood of a major disruptive event and choose an appropriate level of backup.
   - A hot site is a recovery site that is basically a replica of the primary site. All of the systems, equipment, and functionality are available at a moment's notice and all that is necessary is a transfer of personnel from the disabled primary site to the backup. Although the most effective when in a recovery mode, this is the most expensive approach because every aspect of the primary ACC must be acquired in duplicate.
   - A warm site has most of the equipment found in the primary ACC, but requires a short start-up time to be up and running. Activity during this time may include re-directing network resources and phone systems to the new physical location. A warm site is less expensive, but still requires a substantial initial investment.
   - A cold site is little more than a space identified as a backup site. It will have little to no equipment, will take the longest time to get up and running in an emergency, and is the least expensive option.
2. **Distance from the Primary ACC and the Airport**. Another factor in selecting a site for a backup facility is the distance between the primary ACC and the backup site, given that distance will affect various factors (e.g., access by personnel, potential for the same issue to affect both the primary and the secondary sites, and the latency and performance of applications). The goal is to locate the backup site far enough from the primary site so that both are not affected by the same event, but near enough to mitigate other potential issues.
3. **Seismic Zone Details.** A seismic zone is a region where seismic activity is usually constant. An airport probably cannot locate its backup ACC in a different seismic zone, but assessing the likelihood of an event is important for determining the level of investment needed for the type of backup site developed.
4. **Environmental Details.** Environmental details (e.g., weather) should be assessed for likelihood and risks should be considered when determining the level of investment needed for the type of backup site developed.
5. **Network Latency.** For the backup strategy to work, the redundant ACC must be capable of communicating the same way as the primary site. The same level of network communication throughput must be made available at both sites.

SECTION 9

Recommendations

This section of the Guidebook can be used by any size airport and by airports seeking to expand an existing ACC (rather than developing a new facility) and summarizes the optimal process and best practices. It can also be used as a checklist of critical ACC implementation steps.

There is no one best approach. Each airport operator should determine what is needed for their particular initiative. By following all (or even some) of the guidance provided here, a successful initiative is more likely.

(Note: the most critical recommendations are in bold face and numbered sequentially.)

9.1 Section 1, Introduction

Section 1 defined an ACC as "a central physical location in an airport where one or multiple internal (and potentially external) organizations work together to develop a comprehensive picture of one, many, or all aspects of airport operations. The ACC gathers data from various sources using various methods and produces information to portray an accurate picture of airport conditions on which informed management decisions can be made. The ACC is an integral focal point for airport operation through normal conditions, irregular operations, and emergency situations."

Throughout the following recommendations, the information and best practices provided are intended to achieve a facility that strives to meet this definition.

Some initial questions should be answered, beginning with "Why is the airport management initiating an ACC project?"

- Why is this an important project for the airport at this particular time?
- Why does this airport need a communications center?
- Why should the airport operator invest the resources necessary to complete a successful airport project?

After it has been determined that initiating an ACC project is justified, what the new facility would do should be addressed. Related to this are the following questions:

- What array of services is the facility expected to offer?
- What information does the airport operator believe is necessary for obtaining the situational awareness it is seeking?
- What are the potential constraints on developing an ACC?
- What are measurements for success in the ACC effort?

Recommendation 1: Draft a preliminary ACC mission statement based on the perceived need and an early indication of the proposed functionality of the ACC.

Once it is determined that the airport needs an ACC and there is a basic understanding of what it will be doing, identifying the human resources (i.e., who will make the plan a reality?) is critical. This question should be addressed in two different contexts: (1) in terms of the identity of stakeholders, individual or organizational, internal and external, who will play key roles in the operation of the communications center; and (2) the staff and/or contractors who will actually design, develop, and implement the ACC.

Recommendation 2: Identify the individual who will lead the effort from start to finish as early in the process as possible.

The next question to answer is when the project will be initiated and if external factors may guide a completion date. Having a clear desired projection for completion that is sufficiently flexible to allow full testing and training and to ensure that any support applications are fully ready to be integrated into the ACC based on the desired opening is essential.

Recommendation 3: Develop an approach to schedule setting that looks at all airport activities, resource and funding constraints, and any external needs that may be influencing schedule and establish an environment where a realistic schedule can be developed.

The fifth question focuses on the physical location of the ACC or "Where" and an early indication, if possible, helps to frame much of the following discussion.

The last question relates to the delivery method and addresses how the facility can be successfully developed, and implemented, based on the information developed from a Concept of Operations.

Recommendation 4: Commit to developing the ACC through a formal process, instead of relying on ad hoc committees and the efforts of individual airport personnel.

9.2 Section 2, Components of an ACC

Because an ACC can have various configurations, consider a wide range of factors. Specific recommendations regarding areas of exploration as an airport determines what its ACC will be when completed follow.

The first recommendation requires the establishment of a policy-driven environment. A robust, comprehensive, documented set of policies is essential for every ACC, no matter the size. One of the most important potential benefits of an ACC is that an airport will produce the same (or similar) desired outcome each time it encounters a particular condition or stimulus.

Recommendation 5: Commit to a philosophy that the ACC will adopt a policy-driven approach to management and will establish a formal policy document that is highly structured in its development, format, and content.

Deciding whether or not the ACC will also function as a call center is important because that decision affects organization, physical layout, technology, and a host of other decisions.

Recommendation 6: Make a preliminary decision on whether or not the ACC will have a call center function for any or all of the following functions: public inquiries, tenant issues, maintenance requests, and/or public safety.

Throughout this guidance, a standard approach to implementing the technology for the ACC is discussed. An ACC should be approached from a technology perspective using common technology acquisition methods.

Recommendation 7: Commit to (1) understanding the technology needs of the ACC as early as possible in the ACC planning stage and (2) using traditional technology approaches, especially in the creation of a functional requirements document (FRD) to ensure that the technology being selected meets the needs of the users and stakeholders and the objectives of the ACC.

Perhaps the most potentially difficult aspect of developing a new ACC is ensuring that the personnel who will be in the ACC are fully aware of the mission, goals, and objectives of the ACC. The ACC's mission, goals, and objectives need to be developed, approved by airport management, and clearly stated in a documented format available to all personnel. Also there needs to be an understanding of how formerly separate organizations will be expected to work together.

Recommendation 8: Do not understate the importance of staff input into the ACC initiative, and commit to a highly interactive approach for communication and training throughout the process and into operations.

When considering developing an ACC, the airport operator needs to consider three areas of potential communication channels: (1) the internal airport organization; (2) other airport stakeholders (e.g., airlines, tenants, concessionaires, vendors, ground transportation organizations, ground services, and catering); and (3) entities external to the airport, including the immediate community; the airport board; and federal, state, and local agencies (particularly those that have direct oversight or input into airport operations).

Recommendation 9: Draft a preliminary pictorial representation of the potential communication interactions between the ACC and the airport organization, the airport's direct customers, the public (including the surrounding community and the media), external government agencies, and the airport governing body because this will help to inform numerous future decisions.

Depending on the size and scope of an airport's ACC, it may have many elements that are also important components in the NIMS Incident Command System (ICS). In fact, the FEMA definition for ICS as a "standardized approach to the command, control, and coordination of emergency response providing a common hierarchy within which responders from multiple agencies can be effective" is remarkably similar to a large-scale ACC's mission statement. As such, it is beneficial for an airport operator to consider if or when the ACC may be made available during emergencies or "events," as defined by the ICS.

The most compelling connection between an ACC and ICS may be the technology included in the ACC. In both cases, converged communications are essential for successful execution of the operation. ICS requires that an integrated voice and data communications system, including equipment, systems, and protocols, be established prior to an incident—exactly what is implemented when establishing an ACC. Using an already established technology platform for both the ACC and ICS could benefit the airport operator in terms of consistency, cost, uniformity, and readiness to use in the event of an incident.

Recommendation 10: Decide if the ACC will also function as an EOC.

Because an ACC is the most important node in the airport's communication structure, considering how it will carry out that role affects both organization and facility layout.

Recommendation 11: Determine the feasibility of having airport media relations work directly from the ACC or, if not, how they will carry out their role in the event of an incident of importance to the public.

Recommendation 12: Develop a Data Management Plan to have a full understanding of the data flowing in and out of the ACC.

The amount of data and resulting information flowing into the ACC from different systems poses a challenge to any operation for proper absorption and use in decision-making. Ensuring that the data is accurate, timely, and complete is critical in ensuring that ACC personnel are operating with correct information.

9.3 Section 3, Project Planning

To provide a controlled environment for the new or improved ACC, create a formal project team who will be responsible for all aspects of the ACC design, CONOPS creation, construction (where necessary), installation and/or integration of new systems and applications, and especially for completing the project on time and within the allocated budget.

Recommendation 13: Commit to a formal project management approach to implementation.

In project management, a project charter (also called a project definition or project statement) is a statement of the scope, objectives, and participants in a project. It provides a preliminary outline of roles and responsibilities, outlines the project objectives, identifies the main stakeholders, defines the authority of the project manager, and serves as a reference of authority for the future of the project.

Recommendation 14: Develop a project charter.

A project charter (which is the first critical document and reflects airport management's formal decision to create or expand an ACC) lists the objectives, the key individuals responsible for the initiative, and some of the basic resources, constraints, goals, and objectives.

Recommendation 15: Identify the project sponsor.

Irrespective of the size of the airport or the projected size of the ACC, a project management plan (including a project schedule and budget) is important to create and maintain in order to maintain a disciplined project approach.

Recommendation 16: Develop a formal project management plan which is submitted to and approved by airport management, including the project sponsor.

Addressing timing is critical in planning a successful ACC. Development of an ACC may be contingent on other airport projects or it may be a standalone project. It is essential to have a clear desired projection for completion that is sufficiently flexible to allow full testing and training and to ensure that any support applications are fully ready to be integrated into the ACC based on the desired opening.

The most likely factor in an unsuccessful project is an over-optimistic view that everything will go perfectly and the schedule is developed based on that unlikely occurrence.

Recommendation 17: Using the initial general parameters for project start and completion considered in Recommendation 3, develop a realistic schedule with as little influence from outside pressure as possible, focusing on available resources and funding, internal processes such as procurement and board approval, where necessary, and other factors that influence project delivery.

An ACC project is likely to draw project team members from throughout the airport so as to take advantage of the combined skill and expertise of the airport staff. The project team is essential to a successful project.

Recommendation 18: Select project team members who have experience and are committed to delivering a successful project. These team members are likely doing double duty to participate, so focus on staff members who understand how to prioritize their work efforts with only minimal or no management oversight.

Committing the necessary resources for the entire ACC project is important. An ACC can be an expensive undertaking and providing a rough order of magnitude of the necessary resources up front helps to frame the final requirements for the ACC. This includes funding for project management, personnel, integration of existing and planned infrastructure, architectural components, coordination of planning and design, and other locally unique activities and assets to be accommodated for the project to move forward.

Recommendation 19: Develop a rough order of magnitude (ROM) budget for the ACC initiative, with ROM being defined in the *Guide to the Project Management Body of Knowledge (PMBOK® Guide),* as from –25% to +75% of final cost.

Developing a project risk approach is essential in every ACC implementation. Even for the smallest project, a realistic look at obstacles to progress is essential. A typical project-oriented risk structure may be used which identifies potential threats to proper project completion, impact level, likelihood, and mitigation steps.

Recommendation 20: Perform a formal project risk assessment.

9.4 Section 4, Concept of Operations (CONOPS)

One of the documents most needed for a successful ACC initiative is a Concept of Operations outlining the characteristics of a proposed organization, function, or system from the viewpoint of the stakeholders who will use that organization, function, or system. The CONOPS is used to communicate the quantitative and qualitative characteristics to all stakeholders, especially between management and staff. Initially, the CONOPS is created to express the needs and goals of the stakeholders to the project team. Subsequently, the developers create or update the CONOPS to communicate the early design possibilities to the users for review and approval. In most successful projects, the CONOPS is updated throughout the development cycle and, ultimately, becomes part of the operations and support documentation.

Recommendation 21: Develop a CONOPS for the ACC.

The first step in initiating the CONOPS process is for airport management to select the team of airport personnel who will specifically be responsible for CONOPS development. The CONOPS Team may be a subset of the Project Management team or actually be the project management team. This is usually decided based on the breadth and scope of the proposed ACC, whether or not construction is involved, and the number of new systems and applications being considered for the proposed ACC.

Recommendation 22: Choose the best subject matter experts for developing the CONOPS. Individuals should not only understand airport processes and procedures, but also reflect the wants and objectives of airport management.

This Guidebook outlines one method for completing the CONOPS, the resources needed, and a recommended format.

Recommendation 23: Choose a format for the CONOPS before you begin developing the document and stay with it through implementation and then to operations.

Stakeholder engagement is essential in developing facilities and systems in airports. Unless airport management and staff are fully engaged, it will be difficult to develop operational requirements, which is the goal of a CONOPS.

Recommendation 24: Engage stakeholders to the greatest extent possible during CONOPS development.

Situational Awareness is the perception of events and activities in real or near-real time as seen by an individual or group and their understanding of how those events and activities may be related. More simply stated, situational awareness is knowing what is going on from moment to moment so the ACC operator can react, if and when required. If the airport is going to use the ACC as a center for situational awareness, it is important to determine this early in the project.

Recommendation 25: The airport operator must decide on a common understanding of situational awareness and, the most important aspects of situational awareness and agree on a commitment to collecting the necessary data for situational awareness.

To provide a structured approach to situational awareness, the airport operator should create a standardized situational awareness template outlining specific airport scenarios that may occur, identifying information inputs and metrics for identifying severity, and providing an approved response to the situation.

Recommendation 26: Adopt the situational awareness template which identifies priority factors which the airport deems necessary for decision-making and commit to keeping it updated and maintained as new factors are added.

9.5 Section 5, ACC Design Concept

The design of the physical layout, determination of location, and selection of equipment contained within the ACC are essential in the planning process. To ensure that human factors are sufficiently addressed in ACC design and operation, consider the perspective of the end users.

Recommendation 27: Make the "human factor" a key consideration in all ACC design decisions from both a physical perspective and in terms of their ability to absorb the magnitude of data that will be flowing through the ACC.

The final question of the six "who", "what", "why" . . . questions is "where" and is answered in the design phase. The answer to the "where" question is based on two underlying questions: (1) Is the ACC going to be a newly constructed facility, or (2) will it be incorporated in an existing structure?

Recommendation 28: Choose an ACC location that (1) is safe and secure, (2) has easy access to all necessary physical components, and (3) provides access to critical airport facilities. If no such location exists, determine how to mitigate any deficiencies as early in the planning process as possible.

The design intent explains the ideas, concepts, and criteria considered important to airport management and expressed in the project charter. The Basis of Design (BoD) is the documentation that explains the processes and assumptions behind design decisions made to meet the design intent. The design intent evolves from more general descriptors to more specific descriptors during actual design, to in-depth and specific descriptors during the specifying stage, which are finalized during the as-built phase. Under each area or building system is an outline of the building construction and operation requirements to meet the needs of the owner and the building occupants.

Recommendation 29: Develop a Basis of Design document which identifies for the facility designers all of the priority functions and features essential in the facility.

Recommendation 30: Design for scalability, reliability, maintainability, and availability.

When planning facilities, the symbiotic relationship between design and construction must be addressed. Broadly speaking, design is a process of creating the description of the ACC, usually represented by detailed plans and specifications; construction planning is a process of identifying the activities and resources required to make the design a physical reality.

Recommendation 31: For either new construction or even minor rehabilitation, develop a full set of design documents to guide construction.

In addition to typical human factors aspects, the ACC must comply with the Americans with Disabilities Act (ADA) and possibly other regulatory requirements, depending on individual staff members' needs.

Recommendation 32: Consider the disability requirements of persons, internally or externally, who may be using the ACC.

In considering the optimum layout, users of the system will be arranged so that there is a balance of collaboration and face-to-face communication, along with a degree of privacy and isolation and acoustic separation in the performance of activities. During daily operations, certain events and the response to these events call for console operators to consult with one another—this should be possible by turning in one's seat to discuss a situation with an adjacent console operator.

Space planning may need to accommodate a range of situations—from immovable architectural obstructions to a free arrangement and ideal positioning of consoles, furniture, support hardware, and displays. The ceiling height and beams in the ceiling directly affect how the space will be used, how the line of sight to shared displays will be accomplished, and how sounds will be perceived. It may be feasible to array consoles in an arc or circle, a cluster, or in a linear row-by-row fashion, providing adjacency for related functions.

Recommendation 33: Use a professional space planner, even for the smallest ACCs, and include all of the elements which mitigate the effect of a high-stress, fast-moving operation.

Because ACC staff will likely be seated for long periods, the layout and types of furniture selected must be appropriate to the task.

Recommendation 34: Acquire furniture, chairs, and other ergonomic features which mitigate the negative effect of ACC environmental conditions.

Lighting is extremely important to creating an environment conducive to information absorption and situational awareness. Lighting that is too bright or causes glare can seriously reduce information absorption and situational awareness and must be avoided. Overall lighting levels should be lower than in a normal office environment to enhance viewing of display screens.

Recommendation 35: Consider how to ensure that both natural and artificial lighting complement the ACC environment.

Sound control is important to maintaining information absorption and situational awareness, especially in high-stress environments like ACCs that also experience emergency situations.

Recommendation 36: Perform acoustic testing and adjust surfaces and layout if necessary to ensure that the sound environment is conducive to a good working atmosphere.

9.6 Section 6, Construction and Activation Activity

Construction management is typically an airport business practice that has been well defined in past projects. There are a few recommendations which are best practices for developing an ACC, and they include the following.

The airport probably has a construction oversight and monitoring process. In most cases, the actual construction of an ACC is a sub-project of the entire ACC initiative. This is the best approach, given that construction management principles and techniques would likely not blend well with many of the special requirements of an ACC project (e.g., developing a CONOPS). Nevertheless, close coordination between the ACC project manager and the construction project manager is essential, and the best possible scenario is one where the construction schedule is integrated into the total project schedule and regular written progress reports are provided from the construction management team to the ACC project manager.

Recommendation 37: Establish a close working relationship between the ACC PM and construction activities.

Throughout the construction or renovation process, it is often helpful to provide the projected ACC personnel with walk-throughs of the future facility. Such walk-throughs help to familiarize personnel long before training, orientation, and opening day occur and increase their comfort levels.

Recommendation 38: Before opening, have a formal orientation day

It is critical that the ACC open successfully, and no factor is more important for a successful opening than having all equipment, systems, and utilities working properly. It is essential that when the ACC opens, airport personnel can function solely on the new workflows, communications, and processes that have been developed.

Recommendation 39: Ensure that all components of the ACC (physical, environmental, and technological) are fully tested and working prior to opening.

A critical stage in the opening of an ACC is activation—the process of preparing for the new facility's opening day. Activation requires many activities and the engagement of airport management and operations and maintenance staff as the facility moves from construction to operation. A successful activation includes accounting for operations and maintenance preparedness in contracts, schedules, and budgets during the early phases of the project; implementing orientation and technical familiarity training; completing staffing and training; concluding business arrangements such as leases; and preparing and conducting operations and emergency simulations and trials.

Recommendation 40: Conduct a formal activation exercise where all system components and applications are tested to ensure that they not only physically work, but also meet the needs of the users.

Training is a critical component in the pre-opening activities of the ACC. Although the actual training and orientation are not difficult to conduct, scheduling of such events is often fraught with difficulty. All of the personnel who need the training and orientation are likely engaged in critical airport management activities.

Recommendation 41: Ensure that a full training program is developed for all relevant systems and that staff have sufficient backup to ensure that they can attend and concentrate on the training.

9.7 Section 7, ACC Technology

In recent years, significant developments in communication technology have occurred that affect an ACC, including security, the magnitude of data flow and how it can overwhelm human absorption rates, and the legacy systems present and their rate of successful use.

Because technology is at the heart of the ACC, management needs to ensure that special attention is given to the selection, acquisition, implementation, operation, and maintenance of technology. The first (and, perhaps, most important) factor to consider is that in the ACC in consideration will probably be a combination of new systems and the extension of legacy systems in use in the airport. This will require a careful look at the functionality of all prospective legacy systems being considered for the ACC, their usefulness, their ability to integrate into a new environment, the quality of the data, and the acceptance of the system by its current user group.

Recommendation 42: Engage the airport's IT department as soon as the project is initiated to ensure that they are fully aware of the demands that will be placed on the existing airport IT infrastructure and to ensure that all new systems and applications can be integrated with legacy systems.

Given that the airport's IT staff has a wealth of knowledge about IT resources and are familiar with the strengths and weaknesses of the current infrastructure, they are the best source for determining how much additional load an existing infrastructure can absorb without upgrade. Having the IT staff involved from the onset of the project is essential. In fact, in larger airports, if IT staff resources are sufficient and they maintain a project management office, it may even be possible to have the IT department lead the ACC effort, given that the ACC is built on technology.

Recommendation 43: Engage a system integrator, if necessary, to ensure that all systems work together to produce the desired outcome.

A system architecture is the conceptual model that defines functionality, processes, structure, and expectations and provides a graphical and written description of a system structure. An architecture description is a formal document and representation of a system, organized to provide a clear picture of how the system operates, how its components interact, and the expected business benefit for each application in the environment.

Recommendation 44: Considering the ACC as a system, develop a formal system architecture which comprises all of the elements of the ACC, how they interrelate, hardware and software components, and inputs and outputs.

Virtually any application existing in the airport in the current environment and a host of new systems are candidates for inclusion in the ACC. Choosing which systems to place in the ACC environment is a decision process that must be well-informed.

Recommendation 45: Using the ACC system architecture, determine which legacy systems will be included in the new ACC and identify new systems to be added.

All of the applications used by the ACC will "ride" on the backbone of the airport's network. Its data-at-rest and data-in-motion will reside/flow in the airport's data centers and telecommunication rooms. Although it is easy to overlook because, for the most part, it is not visible (except for the physical nature of the data center and telecommunication rooms), its criticality cannot be emphasized enough.

Recommendation 46: Ensure that the underlying IT infrastructure is robust, scalable, and redundant for the new ACC design, from the perspectives of both the passive physical infrastructure and the active network.

The workstation is the most important aspect of ACC design and special care must be given to the form factors which make up the configuration. ACC personnel are likely to be seated at a workstation for most of their working hours and comfort and utility are critical to ensure that they can focus on the subject matter, rather than their surroundings.

Recommendation 47: Ensure that technology components integrate well into the ergonomic furniture and are easily adjustable to meet the needs of individual users.

There are many ways to display information in an ACC, and all available options should be evaluated for the particular requirements of the ACC during the design phase of the project. Depending on the physical size and layout, the ACC may have a video wall, separate video display screens arrayed throughout the facility, video monitors on each workstation (in some cases multiple monitors), or some combination of all three.

Recommendation 48: Decide how to best display information in the ACC, using a combination of video walls and individual monitors and taking into consideration sightlines, lighting, and other environmental factors.

Broadband Internet access to the World Wide Web and email is vital for ACC participants (especially during emergencies) for communicating with external agencies when traditional wire or radio links are unavailable. Internet access will be essential for participants in the EOC, who in many instances will be representing other agencies in remote locations and will need to access their home networks.

Recommendation 49: Determine the best solutions for connecting the ACC with the outside world.

Although airport operations are usually the most likely ACC participant, other entities such as public safety and maintenance could also play key roles in an ACC. If the airport maintains a formal SOC, co-locating or incorporating that functionality into an ACC could benefit communications.

Recommendation 50: Make a formal decision on which of the airport's organizations will have technology resident in the ACC and how it will function in that environment.

Locating some elements of the IT department in the ACC is prudent and potentially prescient, especially in the event of a major emergency. IT services could range from simple desktop support, to placement of a network operations center (NOC) or an information security operations center (ISOC) if the ACC is large enough to warrant dedicated staff.

Recommendation 51: Determine if the IT department will have a physical presence in the ACC and, if so, what that presence will be.

Situational awareness involves understanding the relationships of events and information relative to an airport's point of interest in both time and space. In an emergency, data moves in real time, and data not available when a decision needs to be made is not of use.

Recommendation 52: Determine if the airport operator will acquire situational awareness software.

Securing the technology used in the ACC is of critical importance. As the airport becomes more reliant on the ACC, the corresponding systems that provide the ACC with data become more important. Their continued availability, confidentiality, and integrity is of paramount importance and every step necessary to ensure the successful operation of the systems and applications should be taken.

Even for small and medium-sized airports, security begins with security governance. As either a component of the Facility Security Plan or as a standalone initiative, ensuring proper security controls is essential to system security.

Recommendation 53: Create a technology security governance committee and approach to ensure that all ACC systems are protected physically and from a cyber perspective.

Recommendation 54: Perform a cybersecurity risk assessment.

Some elements of the ACC, such as video surveillance and the massive amount of data that it generates, raise legal considerations that affect system planning, design, and operational usage patterns. From the placement of cameras to the safeguarding and retention of the data collected to the access, use, and dissemination of that data, security system planners and designers must be mindful of requirements imposed by federal, state, and local laws.

Recommendation 55: Include airport legal counsel on all aspects of the ACC design, functionality, system components, and data and information considerations.

9.8 Section 8, Operations

The primary mission of an airport staff is to ensure continuous, safe, secure, and efficient operation of everything within the physical boundaries of the airport, including runways, terminals, roadways, support facilities, perimeters, and critical infrastructure. A good working environment is critical to bringing about the clear, direct, and coherent communications necessary to achieve this goal.

A critical element in maintaining the effectiveness of the ACC, once it is implemented, is to ensure that it evolves with changes in the airport organization, structure, and mission. Major changes in the airport's operations, such as a shift to a fully common use airport or the opening of a new runway or terminal, will have a major effect on the ACC. However, even the smallest change could affect the systems, processes, and procedures in place, and ACC management must make the appropriate modifications necessary to ensure that changing conditions have been properly reflected in the all of the ACC's supporting documentation, including the CONOPS, situational awareness templates, policies, and SOPs.

Depending on the structure which the airport director has chosen for ACC management, this responsibility falls on the shoulders of the ACC manager or a committee of those organizations represented in the ACC. Whatever the management structure, changes must be reflected in a timely and accurate manner consistent with the operational change.

Recommendation 56: Ensure that the roles and responsibilities for ACC management reporting lines are clear.

The CONOPS embodies the intended mission and functionality of the ACC. As the number of systems increases and the complexity of the systems grow, it is more important than ever for all ACC personnel to fully understand the CONOPS. The CONOPS provides the operational guidance that dictates how the systems should be used, the information that will be provided, proper maintenance of the system, and how the system will complement their own skills and expertise.

The basic outline for a set of operating procedures will be established during the development of the CONOPS, in which stakeholders consider each ACC function, the information needed for that function, the decision-making process, and the parameters available on which to make decisions and achieve the desired outcome. The ACC SOPs are based on the CONOPS. Virtually every function listed in the CONOPS will have at least one (and likely many) corresponding SOP. The ACC SOP document consists of step-by-step information on how to execute a specific ACC task. The airport probably has a comprehensive document or at least several policies and procedures previously created. It may be that the airport's primary goal is to simply compile all of its outstanding procedures, re-write them in a common format, and publish this as its SOP document.

Recommendation 57: Develop a systemic and consistent approach to the development, maintenance, and use of SOPs.

Management of ACC personnel is perhaps one of the biggest challenges in the airport environment. Depending on the functionality of the ACC, the size of the staff, the number of systems, and the level of activity in the airport, the stress level of ACC personnel can be high. This is especially true during irregular operations and emergency conditions.

Recommendation 58: Stress the importance of the ACC personnel as a factor when making ACC-related decisions.

All ACC personnel should be familiar with and trained on all aspects of the ACC's operations. As procedures are added, revised, or eliminated, continued training of ACC personnel is essential to ensuring effective operations.

Recommendation 59: Commit to regular training of ACC personnel and testing of procedures and processes (especially emergency or irregular operational procedures), to ensure that they are understood and can be carried out when needed,

Ensuring that the ACC maintains a comfortable working environment is critical. Every aspect of the working conditions, from lighting to temperature control to physical space, must be maintained in the most pleasant condition possible. Typically, the airport's facility management staff will be responsible for the physical nature of the ACC.

Recommendation 60: Designate one individual with the authority and responsibility to ensure that all physical and environmental components in the ACC meet acceptable working conditions.

The safety and security of the ACC are of critical importance. As the nerve center of the airport operation, the ACC must be able to operate without interruption in the event of any natural or human-made occurrence. A risk assessment is recommended for during the project management phase of the project implementation. The risk assessment should cover any potential risk the ACC could face. Revisit the risk assessment regularly (at least annually) to ensure that risks are correctly listed and that mitigation activities remain relevant to the risk.

The airport operator should continually update its risk assessment and develop mitigating actions in a formal plan. The plan and actions should be overseen by a committee tasked with ACC security, typically called an FSC.

Although the ASP may be sufficient for the rest of the airport, the security of the ACC requires additional review and from a larger group than the public safety organization. A formal FSC should be created specifically to manage ACC security. The public safety group is included in this group and, ultimately, all decisions could be included in the ASP.

Recommendation 61: Create a formal FSC to manage the ACC's security.

The FSC is responsible for ensuring that a written Facility Security Plan is developed specifically for the ACC.

Recommendation 62: Create a formal Facility Security Plan for the ACC.

If the primary ACC location is disabled for any reason, natural or human-made, the airport must have a business continuity plan to temporarily relocate its ACC personnel to a backup facility where the critical functionality of the ACC can be conducted until the primary facility is restored.

Recommendation 63: Choose an appropriate backup site for the primary ACC.

APPENDIX A

Concept of Operations Reference Guide

General

- *Key Concepts in Operations Management*, Michel Leseure, 2010, SAGE Publications
- *Strategic Operations Management*, Steve Brown, 2015
- "1362-1998 - IEEE Guide for IT - System Definition - Concept of Operations (CONOPS) Document," IEEE December 22, 1998 and updated August 06, 2002. (This is standards-type document describes the format and content of a CONOPS document for an IT system, including how users and other stakeholders can establish system quantitative and qualitative characteristics, and how to address user interactions with the system.
- *Concept of Operations for the Future Digital System*, U.S. Government Printing Office, October 01, 2004
- "Operational Concept Description (OCD)", U.S. Department of Defense DI-IPSC-81430A, January 10, 2000
- "Concept of Operations for Commercial Space Transportation in the National Airspace System" Version 2.0, U.S. Federal Aviation Agency, May 11, 2001 http://www.faa.gov/air_traffic/satms/media/CONOPS_narrative_v2.pdf

Systems Engineering

Systems engineering integrates the CONOPS approach with developing technical solutions. Examples of system engineering documents that address the standards process in both technical and management respects and that have general applicability to airports and to airport security systems follow:

- *ANSI/EIA-632*, Processes for Engineering a System. Provides an integrated set of fundamental processes to aid in the engineering or re-engineering of a system.
- *IEEE Standard 12207:2008 (ISO/IEC 12207:2008(E))*, Systems and Software Engineering—Software Life Cycle Processes. Establishes a common framework for the supply, development, operation, maintenance, and disposal of software products and the software portion of a system, whether performed internally or externally to an organization.
- *IEEE 42010:2011 (ISO/IEC)*, Recommended Practice for Architectural Description of Software-intensive Systems. Addresses the creation, analysis, and sustainment of architectures of systems through the use of architecture descriptions.
- *ISO/IEC 15288:2008, System Life Cycle Processes*. Establishes a common framework for describing the life cycle of systems created by humans and defines a set of processes and associated terminology within that framework.
- *IEEE 16326, Systems and Software Engineering Project Management*. Specifies the content of a project management plan.

APPENDIX B

CONOPS Template

CONCEPT OF OPERATIONS

FOR

AIRPORT NAME

____
Airport Director **Date:**

____
Project Manager **Date:**

____
ACC Manager **Date:**

Record of Reviews and Changes				
Change ID	**Date Reviewed**	**Date Approved**	**Comment**	**Signature**

Concept of Operations
TABLE OF CONTENTS

Executive Summary

The Executive Summary, usually around two pages long, should summarize the purpose of the document, including any guidance which is meaningful to the preparation and approval process of the CONOPS. The Executive Summary focuses the stakeholder's attention on the most important aspects of the CONOPS document and provides sufficient information for the executive decisionmaker to understand the purpose and contents of this conceptual document.

1. Mission Description

The Mission Description is an overview of the ACC's goals and objectives, underlying mission and business rationale, the current (As Is) Architecture, a list of key stakeholders and expectations, and the current gaps in capabilities that require resolution. It also looks at the future of the ACC and begins to lay the framework for potential expansion of the ACC as the mission evolves.

1.1 Mission Statement

A succinct one- to two-paragraph statement which embodies the purpose and function of the ACC. It will be used continually when adding new functionality to the center.

1.2 ACC Goals and Objectives

Enter Airport Management's Goals for the ACC. These are broad-ranging statements which describe the ultimate achievements that management is seeking with the ACC. For each goal, enter the concrete objective(s) to be attained within the overall goal statement.

1.3 ACC System Architecture

This section describes the current systems operating in the ACC and includes the following:

- The operational environment and its characteristics
- Major system components and the interconnections among these components, operational nodes, activities performed at each node, and connectivity and information flow between nodes
- Interfaces to external systems or procedures
- Capabilities or functions of current systems, including activities and relationships among activities, inputs and outputs, constraints, and mechanisms that perform those activities.
- Charts and accompanying descriptions depicting inputs, outputs, data flow, and manual and automated processes sufficient to understand the current system or situation from the user's point of view
- (Optional) Performance characteristics (e.g., speed, throughput, volume, and frequency of individual systems)
- (Optional) Quality attributes (e.g., reliability, maintainability, availability, flexibility, portability, usability, and efficiency)
- (Optional) Provisions for safety, security, privacy, and continuity of operations in emergencies

2. ACC Operational Context and Architecture

The ACC operational context clarifies the boundaries of the center as it is being conceived. This section describes the placement of the ACC within the airport organizational structure, types of users or personnel contained within the ACC, training and skill required, responsibilities, activities, and interactions with one another. This section also includes a Command Relationship Chart detailing the command, control, and coordination of all organizational components in the ACC.

In this section, the following six components should be addressed:

- Current functional components of the ACC
- Current organizations, roles, and responsibilities
- Current policies, including regulations, procedures, and standards of all entities which may govern activities in the ACC, including the airport, the FAA, and NIMS
- Projected ACC performance drivers
- Existing communication protocols and standards and intended modifications
- Current and projected personnel numbers, skills, and competencies

3. Organizational System Drivers and Constraints

3.1 Outline the Airport Operational Approach
Identify the airport's approach to operational management, situational awareness, and other functions being operated from the ACC.

3.2 Legal Requirements Specifically Related to the ACC
List all legal requirements that apply to the ACC.

3.3 Identify External Airport Organizations That Support the ACC and Describe Their Roles
List all entities external to the airport that may have a role in working with the ACC, including IROP and emergencies

3.4 Identify Any Organizational Constraints that Impact the Entire ACC

4. Center Functions

4.1 Individual Center Functions
This section will include an entry for each of the functions (see Appendix C) contained within the ACC and the following sections will be repeated for every function:

- Function Title
- Detailed description of the function. This paragraph provides a detailed description of the function and should include, as applicable:
  - A description of the function
  - The function's operational environment and its characteristics
  - Operational Scenarios, including the situational awareness template, where applicable. Include one or more operational scenarios that describe the role of the function and its interaction within the airport's internal and external stakeholders. The scenarios should include events, actions, stimuli, information, interactions, and so forth, as applicable.
- Related CONOPS Functions. List any other function managed in the ACC that has a tangential relationship to the function.
- Related Airport Functions. List any other function managed elsewhere in the airport that has a tangential relationship to the function.
- Information Foundation. Include all of the following:
  - Inputs to the function from systems, reports, regularly scheduled meetings, including interfaces to external systems or procedures
  - All outputs from the function

- Constraints or obstacles that affect the function - This paragraph describes any operational policies and constraints that apply to the function
- The primary manager of the function and their reporting structure
- The roles and responsibilities of all airport staff responsible for the proper execution of the function
- The intended outcome of the function – describe the airport's intended successful objective in performing this function, including goal and related objectives
- Performance metrics which measure a successful outcome for the function – list performance indicators which identify a success level for the function

5. Operational Scenarios

List any major scenarios that affect the ACC in its entirety. For example, list all situations which the airport considers as a "major event."

6. Implementation Concepts and Rationale

Describe how the ACC was developed and the rationale used to justify its development.

7. ACC Operational Architecture

Describe the ACC in a graphical representation, depicting all of the information flows, systems, and inputs and outputs. Include the interface to non-ACC systems where relevant.

8. Organizational and Business Impact

Describe airport management's view on the effect that it expects the ACC to have on the business of the airport organization and its stakeholders (e.g., community, airlines, and concessionaires).

9. Risks and Technology Readiness Assessment

Include either the initial risk assessment developed for the ACC or the most current risk assessment.

10. Notes

This section may contain any general information that aids in understanding the CONOPS for the ACC.

11. Appendices

Appendices may be used to provide additional information related to the ACC.

APPENDIX C

CONOPS Function Template

(AIRPORT NAME) COMMUNICATION CENTER
CONCEPT OF OPERATIONS
FUNCTION DESCRIPTION

FUNCTION REFERENCE NUMBER:

DATE ESTABLISHED: ___________

LAST REVISION: ___________

Function Title: ________________________________

Detailed Description:

Related CONOPS Functions:

Related Airport Functions:

Information Foundation for the Function (systems, meetings):

Constraints or Obstacles:

Performance Metrics:

Function Goal and Expected Outcome:

Function Manager:

Responsible Staff and Roles:

APPENDIX D

Situational Awareness Template

Sample Situational Awareness Template

Situation Name and/or Short Description:

Situation Reference Number:

An airport should consider developing a taxonomy which allows for easy reference to all situations.

Situational Condition:

Describe in detail.

Severity Metrics:

List any metrics which may be used to measure the severity or size of the situation, including thresholds which trigger actions.

Situation Response:

Describe the airport's response to the situation, taking into account different levels of severity/size as discussed above.

Situation Manager:

Describe the ACC and airport organizational resources required to manage the situation should a threshold be exceeded. Include names, phone numbers, and email addresses.

Situation Contact:

List the airport entities that must be contacted if the situation meets the thresholds described above. Include names, phone numbers, and email addresses.

APPENDIX E

Standard Operating Procedure Template

Standard Operating Procedure

Airport Name:
SOP Number:
Page # of #

Approved Date:
Implementation Date:
Last Revision Date:

1. Purpose

Describe the purpose of the SOP and how it fits within the ACC environment. Describe if it is an airport wide SOP or pertains just to the ACC. Identify the intended audience of the SOP and the situations in which it may be applied.

2. Responsibilities

List all of the organizations and personnel to which the SOP pertains. Identify organizations and personnel specifically responsible for carrying out the SOP.

3. Procedure

Outline the entire procedure in detail. Use specific language so as not to leave ambiguity. Where possible, use a step-by-step approach to accomplishing the procedure. If possible, add a graphic to illustrate the procedure's process flow.

4. Alternative Steps

If applicable, provide the circumstances under which the SOP may be deviated from, alternative steps may be used, or the SOP waived altogether.

5. Definitions

Define any specialized terms or acronyms used in the SOP.

6. Systems and Documentation

Identify any systems that support the SOP, and list all documentation that must be created and/or maintained to record instances where the SOP was used.

7. References

List any references that are useful in understanding the SOP, including cross-referencing with other SOPs, airport regulations or requirements, and federal, state, or local statutes and requirements.

APPENDIX F

Glossary of Terms & Acronyms

AC	Advisory Circular
ACAMS	Access Control and Alarm Monitoring Systems
ACC	Airport Communications Center
ACM	Airport Certification Manual. This is required as part of the airport's governmental operating certification.
ACS	Access Control System (centralized or decentralized, physical or logical)
Access Control	A set of procedures performed by hardware, software, and administrators to monitor access, identify users requesting access, record access attempts, and grant or deny access
ADA	Americans with Disabilities Act
A/E	Architect-Engineer
AEP	Airport Emergency Plan
AES	Advanced Encryption Standard—Reference Encryption Standards
AIP	Airport Improvement Program. An FAA function that provides funding for certain airport planning and development projects at airports included in the National Plan of Integrated Airport Systems (NPIAS).
Airport Operations Center (AOC)	The Airport Operations Center is the focal point for daily airport operational functions, including such issues as maintenance of the airfield, runway surface and lighting, and management of terminal facilities and fueling facilities. It may also include control over gate operations and aircraft maintenance areas (although these may also be tenant functions).
Analog	A video signal made of a continuous electrical signal. Televisions and videocassette recorders can be analog video devices. To be stored and manipulated on a computer, analog video must be converted to digital video.

ANSI	The American National Standards Institute, which develops standards for transmission storage, languages, and protocols and represents the United States in the ISO (International Organization for Standardization).
A_O	Operational Availability
AOA	Airport Operations Area
AODB	Airport operational database. Software that collects, processes, stores, and analyzes airport operation data, flight information, aircraft and passenger status, and other information used to manage airport and airline operations.
APCO	Association of Public-Safety Communications Officials
APD	Airport Police Department
ARFF	Aircraft Rescue and Firefighting
ASP	Airport Security Program
ASTA	Aviation Transportation Security Act
Bandwidth	Capacity of a network or data connection, often measured in kilobits/second (kbps) for digital transmissions. The amount and rate of data that can be processed or transmitted by a given device.
Biometrics	The automated process of identifying a person based on that person's measurable biological or behavioral characteristics.
Biometric Access Control	Any means of controlling access through human measurements, such as fingerprinting or voice printing.
BMS	Building Maintenance System
BoD	Basis of Design
C2	Command and Control
CAD	Computer-Aided Dispatch
CBP	U.S. Customs and Border Protection
CCD	Charge Coupled Device. The "chip" in a solid state camera that replaces the camera tube. A sensor that collects light and turns it into an electrical signal.
CCTV	Closed-Circuit Television
CDMA	Code division multiple access. A channel access method used by various radio communication technologies, where several transmitters can send information simultaneously over a single communication channel. This allows several users to share a band of frequencies (see bandwidth).

Centrex	Central telephone exchange
CFR	Code of Federal Regulations
CONOPS	Concept of Operations
Contrast	The range of light and dark values in a picture or the ratio of maximum and minimum brightness.
CSI	Construction Standards Institute
CUSS	Common Use Self-Service. Describes the specifications and standards for multiple airlines sharing one physical self-service kiosk, primarily for check-in functionality.
CUTE	Common Use Terminal Equipment. Airport-installed software and network equipment which airports use to control gate access and which enables airlines and handling agents to access their own applications at common terminal gates.
dB	Decibel. A logarithmic unit that indicates the ratio of a physical quantity, usually power or intensity relative to a specified or implied reference level.
DHS	The U.S. Department of Homeland Security
Digital Video	A video signal made of binary digits. To store and manipulate analog video on a computer workstation, it must be converted to digital video.
DLP	Digital Light Processing is a type of microelectromechanical systems (MEMS) technology that uses a digital micro mirror device. DLP projector technology is used in various display applications from traditional static displays to interactive displays.
E911/E-911	Enhanced 911 is a system used in North America that links emergency callers with the appropriate public resources using a three-digit dialing scheme.
EMS	Emergency Medical Service
EOC	Emergency Operations Center. The physical location where information and resources support incident management and on-scene emergency activities. An EOC may be a temporary facility, or may be in a more permanently established facility, often near the SOC/AOC. It may be organized by major functional disciplines (e.g., fire, law enforcement, and medical services), by jurisdiction (e.g., federal, state, regional, city, and county), or in some combination.

Ethernet	A local area network (LAN) protocol featuring a bus topology and a 10-megabit per second data transfer rate.
FAA	Federal Aviation Administration
Fail Safe	A locking device that is unlocked when no power is applied. On loss of power, access points will automatically unlock, allowing free access, and signal the card access system of a device malfunction or loss of power.
FAT	Factory Acceptance Testing
FCC	Federal Communications Commission, which oversees frequency usage in the U.S.
FEMA	Federal Emergency Management Agency
Fiber Optics	A medium using light for transmitting either an analog or digital signal. The signal loss is lower than that of coaxial cables and has a higher immunity to electromagnetic and static interference.
Field of View	The image area produced by any camera and lens combination. The horizontal or vertical picture size at a given distance from a camera to the subject.
Fusion Center	A fusion center is a relatively new concept used to provide information for decisionmakers. Fusion Centers are not a true command control structure, but a place where multiple agencies can collaborate to provide resources, expertise, and information.
GB	Gigabytes (billions of bytes)
GIS	Geographic Information System. Applies a spatial component to text data.
GSM	Global System for Mobile Communications is a standard developed by the European Telecommunications Standards Institute to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It is the de facto global standard for mobile communications with over 90% market share and is available in over 219 countries and territories.
HD	High-definition. In video, a type of video derived from broadcast television standards, with higher resolution than standard CCTV video (usually at least 1024x768 pixels) and formatted for 16:9 widescreen displays.

HSA	Homeland Security Act of 2002 (Public Law 107.296 §301, 116 Stat. 2135/2163 (2002). Public law that provides a framework to coordinate federal government civilian efforts.
HVAC	Heating, Ventilating, and Air Conditioning
Hz	Cycles per second
ICAO	International Civil Aviation Organization
ICP	Incident Command Post. The field location where the primary command functions during an incident are performed. The ICP may be co-located with other incident facilities or may be mobile.
IROPS	Irregular Operations at airports
IT	Information Technology
JOC	Joint Operations Center. The JOC combines the functions of various other operations centers (e.g., AOC and SOC) into one integrated system. A JOC could be accomplished physically by co-locating an AOC and SOC in the same location or through a virtual linkage on a common platform.
LAN	Local Area Network
LCD	Liquid Crystal Display
LDCS	Local departure control systems
LMR	Land Mobile Radio
MB	Megabytes (millions of bytes)
MHz	Megahertz
Mission creep	The gradual broadening/expanding of the original objectives of a mission or organization.
MTBF	Mean-Time-Between-Failure
MUBIDS	Multi-User Baggage Information Display System
MUFIDS	Multi-User Flight Information Display System
NCIC	National Crime Information Center. A computerized index of criminal justice information (e.g., criminal record information, fugitives, stolen properties, and missing persons) available to federal, state, and local law enforcement agencies.

NIST	National Institute of Standards and Technology; U.S. Department of Commerce; a primary standards development and issuance body.
Noise	Random spurts of interference
NOC	Network Operations Center
NTSC	National Television System Committee. Formulated the standard of broadcasting color television in the U.S. and Japan: 525 lines of resolution at 60 fields per second, 30 frames per second.
NVR	Network Video Recorder. A networked device for capturing digitally encoded video streams transmitted over the network, storing the video streams, and accessing stored video for viewing.
OSI	Open Systems Interconnection model
OT	Operational Testing
PACS	Physical Access Control System
PIDS	Perimeter Intrusion-Detection System
PSAP	Public Safety Answering Point. An airport PSAP can serve as the focal point for 911 emergency call center service to a larger geographic area outside its fence, receiving and processing emergency calls and event notifications for a specific area. These facilities dispatch public safety personnel such as police, fire, and EMS.
PSFA	The Public Safety Foundation of America
PTZ	Pan-Tilt-Zoom. A type of surveillance camera
PSIM	Physical Security Information Management system
QoS	Quality of Service
RECC	Regional Emergency Communications Coordination
Resolution	A measure of the ability of a camera, recorder, or monitor to reproduce detail. The bandwidth of the video signal relating to amount of detail that determines the quality of the picture.
RFID	Radio Frequency Identification. The wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for automatically identifying and tracking tags attached to objects.
ROM	Rough order of magnitude

SAN	Storage Area Network
SCIP	Statewide Communication Interoperability Plan. Workshops are provided by the U.S. DHS to create locally driven, multi-jurisdictional, and multidisciplinary statewide plans to enhance emergency communications.
SIT	Site Installation Testing
SLA	Service level agreement
SMR	Specialized Mobile Radio
SOC	Security Operations Center. The focal point for airport security monitoring, command and control (C2) and communications functions relative to security operations. In larger airports, this is often physically separate from other operations; smaller airports often include the security function in an AOC.
SOP	Standard Operating Procedure
SQT	System Qualification Testing
SSI	Sensitive Security Information
TCP/IP	Transmission Control Protocol/Internet Protocol. The suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP.
TIA	Telecommunications Industry Association
TSA	Transportation Security Administration
TVA	Threat and Vulnerability Assessment
UHF	Ultra-High Frequency
UL	Underwriter's Laboratories. A testing laboratory that develops standards and test procedures for materials, components, assemblies, tools, equipment, and procedures, chiefly dealing with product safety and utility.
UPS	Uninterrupted Power Supply
User	Any person who interacts directly with a computer system.
User Interface	The part of an application that the user works with. User interfaces can be text driven, such as DOS, or graphical, such as Windows.

VCIN	An automated, high-speed communications system that interfaces with computerized databases at the National Crime Information Center, National Law Enforcement Telecommunications System, FAA, and other federal and state agencies.
VHF	Very High Frequency
VLAN	Virtual LAN
VMS	Video Management System
VoIP	Voice Over IP
VPN	Virtual Private Network
WAN	Wide Area Network
Wi-Fi	A common term for wireless local area networks (LANs) that conform to IEEE 802.11 standards
WLAN	Wireless Local Area Network

APPENDIX G

Industry Technical Standards

1. Standards Bodies

Standards are essential for communication systems and computer networks to function properly. In the United States, the following standards bodies should be of interest to airports:

- The **Institute of Electrical and Electronic Engineers (IEEE)** publishes standards for networking architectures, such as Ethernet networks; for network devices such as a network switch or a wireless access point; and for various electrical power, communications, and other equipment and systems. http://www.ieee.org
- The **Telecommunications Industry Association (TIA)** publishes standards for telecommunication facilities and for the cable plants that serve them, in addition to other standards. http://www.tiaonline.org
- The **Internet Engineering Task Force (IETF)** publishes standards for protocols and devices which operate over the Internet, including protocols for routing datagrams and Voice over Internet Protocol. An IETF standard is a special Request for Comments (RFC) or a set of RFCs. http://www.ietf.org
- The **American National Standards Institute (ANSI)** publishes a wide range of standards and often jointly publishes telecommunication standards with the TIA. ANSI and its largely European counterpart, the International Standards Organization (ISO), also publish complementary standards or cross reference their standards. http://www.ansi.org
- U.S. **National Institute of Standards and Technology (NIST)** publishes standards and guidelines, known as Special Publications, for facility, communication, and network security which are mandatory for federal agencies, unless exempted in PL 107-296, The Homeland Security Act. U.S. Airports are generally not obligated to follow NIST standards, but these documents represent a significant resource for airports to use in modeling their own security programs and especially for network security. http://www.nist.org
- The **International Organization for Standardization (ISO)**. The ISO is the world's largest developer of voluntary international standards. Founded in 1947, it has since published more than 19,500 international standards, covering almost all aspects of technology and business. Many IEEE and ANSI standards are also published by the ISO. http://www.iso.org
- The **International Telecommunications Union (ITU)** is the United Nations' specialized agency for information and communication technologies. It allocates global radio spectrum and satellite orbits and develops the technical standards to ensure that networks and technologies interconnect seamlessly. http://www.itu.int
- **Building Industry Consulting Service International (BICSI)** is a professional organization supporting the information technology systems industry. The IT industry covers voice, data, electronic safety and security, and audio/video technologies. It encompasses the design, project management, and installation of pathways, spaces, distribution systems, wireless-based

systems, and infrastructure that supports the transportation of information between and among communications and information-gathering devices. http://www.bicsi.org

2. Standards and Standards-Related Documents

There is no single U.S. or internationally recognized standard for airport operations (FAA Advisory Circulars are not considered standards, although they do provide useful guidance) or for airport communications and communications centers or even for integrating physical security systems. However, the following standards-type documents may be valuable for airport communications design and planning:

- "Recommend Security Guidelines for Airport Planning, Design and Construction," issued by the TSA on May 1, 2011. See Part III, Section I, IT, Power, and Communications in particular.
- "Integrated Security Systems Standard for Airport Access Control," Document No. 230C, issued by the RTCA on June 21, 2011. See in particular Section 2, Requirements and System Design; Section 7, Security Operations Centers (SOC); and Section 8, Communications Infrastructure. The RTCA intends to publish an extensive update of this standard before the end of 2013, which will contain a new section on System Integration.
- "Ergonomics Design of Control Centers," ISO 11064, published on December 01, 2000. This baseline design document, which adopts the user-centric approach, specifies ergonomic principles, recommendations and requirements for designing control centers for process industries, transportation and other control applications. Although primarily intended for non-mobile control centers, its principles also apply to mobile control centers.
- Human Factors Design Standard (HFDS), published by the FAA and updated on May 03, 2012. This standard provides in one source human factors practices and principles integral to the procurement, design, development, and testing of FAA systems, facilities, and equipment.

3. Communications and Network Standards

Airport communications exist in many forms, including radios for air traffic control and ground communications and the networking of control, security, and other devices. For airport communications centers, coverage of standards includes wireless and wired means of interconnecting various devices so they can function in an integrated manner, as determined by the CONOPS.

Network architectures depend on the application. The common forms are local area networks (LANs) for on-airport operations and Wide Area Networks (WANs) to extend this connectivity off airport. In both cases, the predominant architecture is Ethernet for which IEEE has published several sets of standards.

The IEEE 802.3 series of "Standard for Ethernet" defines wired connectivity for Ethernet local area, access, and metropolitan area networks. IEEE 802.3 defines the physical (PHY) and media access control (MAC) layers of Ethernet transmission across wired connections of multiple media and bandwidth providers.

For wireless LANs, the IEE 802.11 series apply. Generally known as the Wi-Fi bands, the most significant for airport use are

- IEEE 802.11a - operating in the 5 GHz band.
- IEEE 802.11b/g - operating in the 2.4 GHz band.
- IEEE 802.11n - range enhancements for operations in the a/g bands.

All wireless activity in the United States is governed by two agencies: the FCC, which assigns frequencies and controls transmissions, and the National Telecommunications and Information Administration (NTIA), a policy advisory unit of the U.S. Department of Commerce.

The FCC has set aside several frequency bands for unlicensed wireless operations. http://www.fcc.gov. The most popular commercial bands are governed by FCC Part 15 Subpart C, known as the ISM band (for Industrial-Scientific-Medical users) and includes the frequencies used for the Wi-Fi bands. The relevant IETF standards include

- STD 5 (RFC0791) Internet Protocol
- STD 6 (RFC0768) User Datagram Protocol
- STD 7 (RFC0793) Transmission Control Protocol
- STD 9 (RFC0959) File Transfer Protocol
- STD 41 (RFC0894) A Standard for the Transmission of IP Datagrams over Ethernet Networks
- STD 43 (RFC1042) Standard for the transmission of IP datagrams over IEEE 802 networks
- STD 44 (RFC0891) DCN Local-Network Protocols
- STD 51 (RFC1661) The Point-to-Point Protocol (PPP)
- STD 62 (RFC3411) An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
- STD 64 (RFC3550) RTP: A Transport Protocol for Real-Time Applications

Cable Plants

Wired networks, and interconnections to wireless devices, require cable plants. In most cases, the cabling will include both fiber-optic and copper cabling, the latter commonly referred to as "structured cabling."

Standards for fiber-optic cabling are issued by the IEEE and also by the Telecommunications Industry Association (TIA). The areas in which the IEEE has issued fiber-optic standards include

- 100 Gigabit Ethernet
- 10 Gigabit Ethernet
- Fiber Channel
- Gigabit Ethernet
- Synchronous Digital Hierarchy
- Synchronous Optical Networking
- Optical Transport Network (OTN)

The primary TIA cabling standards of interest to airports are

- 568-C.0 Generic Structured Cabling Standard for Customer Premises
- 568-C.1 Commercial Building Cabling Standard
- 568-C.2 Copper Cabling and Components Standard
- 568-C.3 Fiber Cabling and Components Standard
- 568-C.4 Broadband Coaxial Cabling and Components Standard

The TIA 568 series standards should be used with the following complementary standards

- 222 Standard for Antenna Supporting Structures and Antennas
- 569 Telecommunications Pathways and Spaces
- 598 Fiber Optic Color Coding
- 606 Administrative Standard for Telecommunications Infrastructure
- 607 Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- 758 Customer-owned Outside Plant Telecommunications Infrastructure Standard
- 942 Telecommunications Infrastructure Standard for Date Centers

Network Security Standards and Guidelines

NIST is empowered to set security standards for most agencies of the federal government. NIST has published extensively on means to secure both wired and wireless networks. Its publications include both standards and guidelines, known as Special Publications. NIST standards are generally not mandated for airports, which are not federal agencies, but NIST standards constitute a set of "best practices" which can prove valuable to airports by providing ways to secure their communications.

NIST security standards include the following:

- FIPS 201, Personal Identity Verification (PIV) of Federal Employees and Contractors
- FIPS 200, Minimum Security Requirements for Federal Information and Information Systems
- FIPS 199, Standards for Security Categorization of Federal Information and Information Systems
- FIPS 197, Advanced Encryption Standard (AES)
- FIPS 196, Entity Authentication Using Public Key Cryptography
- FIPS 191, Guideline for The Analysis of Local Area Network Security
- FIPS 190, Guideline for the Use of Advanced Authentication Technology Alternatives

Special Publications of NIST include

- SP 800-130, A Framework for Designing Cryptographic Key Management Systems
- SP 800-128, Guide for Security-Focused Configuration Management of Information Systems
- SP 800-127, Guide to Securing WiMAX Wireless Communications
- SP 800-125, Guide to Security for Full Virtualization Technologies
- SP 800-124, Guidelines for Managing and Securing Mobile Devices in the Enterprise
- SP 800-116, A Recommendation for the Use of PIV Credentials in Physical Access Control Systems (PACS)
- SP 800-100, Information Security Handbook: A Guide for
- SP 800-98, Guidelines for Securing Radio Frequency
- SP 800-79, Guidelines for the Accreditation of Personal Identity Verification (PIV) Card Issuers (PCIs)
- SP 800-77, Guide to IPsec VPNs
- SP 800-76-2, Biometric Data Specification for Personal Identity Verification

4. Video Standards

Airports often have several types of command and control centers (e.g., Security Operations Centers (SOCs), AOCs, EOCs, and Police Dispatch Centers, among others. The names vary, though in many cases, the base functions and systems are similar. How these centers interface and share information will depend on the airport, but most make extensive use of video inputs and monitors for which video standards are important.

Several industry groups have standardized protocols for digital video systems and for their integration with other elements of physical security systems. Their common goal is improved hardware and software compatibility, but each group has its own focus, and their standards differ in important respects, including their span of coverage and how they specify and test for compatibility compliance. Examples of standards include

- The Open Network Video Interface Forum is composed of most of the leading manufacturers of video hardware and software. ONVI standards focus on camera, encoder, and software compatibility, including VMS and PSIM integration.

- The Physical Security Interoperability Alliance (PSIA) also includes video manufacturers as members, but it also includes leading access control hardware and software manufacturers and suppliers of building automation systems. PSIA's emphasis is on making these elements interoperable, e.g., being able to hand off access control alerts so that video imagery and decision-making software can use such information.
- The Security Industry Association (SIA) is working on access control integration using specifications of leading access control hardware and software manufacturers, which have been regarded by many system integrators as de facto standards for many years.

Stating that an item of equipment, such as a video camera, "complies" with a published industry standard does not ensure that it will interoperate with "compliant" products of other manufacturers. Even within a given camera product line, there can be models which comply with a given standard while other models do not. Equipment specifications, however detailed, are not sufficient to reveal to an airport operator the full level of operational performance or the compliance of a specific device to a standard. Always check equipment model details against the standards to which they have been tested, and, whenever possible, physically test the products under local operational and environmental conditions of use.

Digital television standards are defined by the coder-decoder (codec) being used. The formats in use include

- CCIR 601, now reissued as an ITU-T standard, for commercial broadcast transmissions
- H.261 (ITU-T)
- H.263 (ITU-T)
- H.264/MPEG-4 AVC (ITU-T + ISO), currently the de facto standard for security video streams
- H.265/ISO/IEC 23008-2 HEVC (ITU-T + ISO), approved in January 2013 as the successor to H.264, is expected to be phased in as high-end products and services outgrow the limits of current network and display technology
- M-JPEG (ISO) used for high-quality compression where sufficient bandwidth is available
- MPEG-1 (ISO) used for video CDs
- MPEG-2 (ITU-T + ISO) used for DVDs and broadcasting
- MPEG-4 (ISO) the de facto standard before H.184, and still widely used in security systems
- VC-1 (SMPTE)

Analog video standards in use differ by region and include:

- NTSC - USA, Canada, Japan
- PAL - Europe, Asia, Oceania
- PAL-M - PAL variation, Brazil and Argentina
- PALplus - PAL extension, Europe
- RS-343 (military)
- SECAM - France, former Soviet Union states, Central Africa
- MUSE - Japan

5. Other Standards and Standards-Related Documents

The Construction Specifications Institute (CSI) develops and publishes specifications, in the MASTERSPEC format, which reflect best practices and standards for commercial building design and construction projects in North America. It lists titles and section numbers for organizing data about construction requirements, products, and activities for use by architects, specifiers, contractors, and suppliers. http://www.csinet.org/?gclid=COTpzeG2_roCFaTm7AodT34Atw

FAA Circulars: The FAA has issued numerous Advisory Circulars (ACs). Although not strictly standards, these documents provide valuable guidance for planning and designing airport communications. http://www.faa.gov/regulations_policies/advisory_circulars/

Federal Regulatory Requirements: Federal agencies have issued regulatory requirements, sometimes, in the form of standards, which affect the planning and design of airport communications facilities. One example is the Americans with Disabilities Act, which the U.S. Department of Justice has implemented in the "2010 ADA Standards for Accessible Design" issued on September 15, 2010. http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm

Other examples are ergonomic and workplace standards and requirements of the U.S. Department of Labor, Occupational Safety & Health Administration, which are available at the following websites: www.osha.gov/SLTC/ergonomics

www.osha.gov/SLTC/etools/baggagehandling/index.html
http://www.osha.gov/SLTC/etools/computerworkstations/components_monitors.html
National Electric Code, NEC, http://www.neccodebooks.com/

Lighting standards: At this time, there are no U.S. Government-mandated requirements for security lighting at airports. Lighting design standards bodies with relevant publications include

- The U.S. Department of Energy (DoE), including standards for SSL products summarized in factsheets and guidelines available at

  http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_standards.pdf

  DoE chairs the Commercial Building Energy Alliance (CBEA), which has released standards for parking lots and parking structures, available at

  http://www1.eere.energy.gov/buildings/alliances/parking_lot_lighting.html
  http://www1.eere.energy.gov/buildings/alliances/parking_structure_spec.html

- The U.S. National Institute of Standards & Technology, which has several standards for LED manufacturing and performance testing.
- The Illumination Engineering Society (IES), which publishes industry standards and best practices. http://www.ies.org

APPENDIX H

Suggested Reading

TRB

TRB has published many reports that contain a wealth of supporting information for ACC planning, design, and operation, including the following:

- A Guidebook for Integrating NIMS for Personnel and Resources at Airports, Report 103, 2014
- Being Prepared for IROPS: A Business-Planning and Decision-Making Approach, Report 106, 2014
- Effective Cooperation Among Airports and Local and Regional Emergency Management Agencies for Disaster Preparedness and Response, Synthesis 50, 2014
- Integrating Community Emergency Response Teams (A-CERTs) at Airports, Report 95, 2014
- Integrating Web-Based Emergency Management Collaboration Tools into Airport Operations—A Primer, Report 94, 2013
- Synthesis 45, Model Mutual Aid Agreements for Airports, 2013
- Operational and Business Continuity Planning for Prolonged Airport Disruptions, Report 93, 2013
- Guidebook to Creating a Collaborative Environment Between Airport Operations and Maintenance, Report 92, 2013
- Issues with Airport Organization and Reorganization, Synthesis 40, 30 May 2013
- Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making, Report 76, 2012
- Application of Enterprise Risk Management at Airports, Report 74, 2012
- Airport-to-Airport Mutual Aid Programs, Report 73, 2012
- Asset and Infrastructure Management for Airports—Primer and Guidebook, Report 69, 2012
- Reference Guide on Understanding Common Use at Airports, Report 30, 2010
- Airport Passenger Terminal Planning and Design, Volume 1: Guidebook and Volume 2: Spreadsheet Models and User's Guide, Report 25, 2010
- Strategic Planning in the Airport Industry, Report 20, 2009
- Guidebook for Conducting Airport User Surveys, Report 26, 2009
- Integrating Airport Information Systems, Report 13, 2009

Regulatory

"Title 14, Aeronautics and Space, Part 139 Certification of Airports, §139.325 Airport Emergency Plan," *The Electronic Code of Federal Regulations (e-CFR)*. (September 2013) http://www.ecfr.gov/cgi-bin/text-idx?SID=b4362b4d352fdd3dcd8c10b0c7aeec4e&node=14:3.0.1.1.14&rgn=div5#14:3.0.1.1.14.4.3.13 (As of September 12, 2013)

Industry

Airport Information Technology & Systems (IT&S): Best-Practice Guidelines for the Airport Industry. Airports Consultants Council (Second Edition, January 2012) pp. 116.

"Public Safety Advisory Committee Human Factors Report." *FirstNet Public Safety Advisory Committee*. (November 2013) (As of June 2, 2014) http://firstnet.gov/sites/default/files/PSAC%20Human%20Factors%20Report-FINAL.pdf

"Guide for Applying the Risk Management Framework to Federal Information System, A Security Life Cycle Approach, Information Security," National Institute of Standards and Technology (NIST) (February 2010) pp. 93. (As of July 6, 2014) http://csrc.nist.gov/publications/nistpubs/800-37-rev1/sp800-37-rev1-final.pdf

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act (2015)
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TDC	Transit Development Corporation
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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