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Approved by the Tactical Operations Committee March 2016

Improving Awareness, Planning and Execution of Airport Construction

Report of the Tactical Operations Committee in Response to Tasking from the Federal Aviation Administration

March 2016

Improving Awareness, Planning and Execution of Airport Construction

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Introduction

Airport construction is critical to maintaining, improving and modernizing aviation. Significant drivers of airport construction include 1) maintenance and modernization of aging infrastructure, including runways, taxiways, terminals and navigational aids, 2) capacity enhancement efforts to accommodate increased traffic demand, increase airport efficiency or reduce delay and 3) safety-driven construction for improvement and compliance with new standards and requirements.

While necessary, airport construction projects can have adverse operational impacts due to temporarily reducing runway capacity or creating taxiway limitations. They also have the potential to affect safety due to the temporary introduction of new risk into the system when construction is on or near the airport. Over the last five years, significant construction projects have been completed at some of the most complex, constrained, and heavily travelled airports in the NAS, including John F. Kennedy International Airport (JFK), LaGuardia Airport (LGA), Newark Liberty International Airport (EWR), San Francisco International Airport (SFO), Hartsfield–Jackson Atlanta International Airport (ATL), Dallas/Fort Worth International Airport (DFW), O'Hare International Airport (ORD) and Los Angeles International Airport (LAX).

Airport construction planning is a diverse and varied process involving many key stakeholders. Federal FAA (Federal Aviation Administration) guidance exists in the form of orders, advisory circulars, and other publications related to design, operational safety during and funding of construction. However, there is a lack of overarching guidance in regards to the planning and execution process as well as the roles of different stakeholders throughout. As a result, coordination, management, and execution of construction projects are subject to wide variation due to numerous factors such as the expertise and experience level of the various stakeholders involved, airport size and governance, and the type of construction. Further, as airport construction involves many stakeholders with diverse backgrounds and perspectives, ensuring proper and timely communication among all stakeholders is challenging. The current diffuse approach, while seemingly workable at the local level, does not support a consistent, repeatable and systemic process and may result in unnecessary or avoidable operational impacts or introduce unwanted risk.

General awareness of construction projects is also an issue, particularly at locations outside of the Core 30 airports. The lack of awareness may leave some stakeholders with too little time to plan and execute mitigations to construction impacts as well as missed opportunities to optimally sequence and implement other related projects, capital improvements, NAVAID upgrades or planned preventive maintenance.

Based on the challenges experienced accommodating recent construction projects, NAS users requested that the FAA initiate a tasking for the RTCA Tactical Operations Committee (TOC) to evaluate and improve the airport construction lifecycle. In a letter dated November 21, 2014, to Margaret Jenny, President, RTCA, FAA ATO Vice President, Mission Support Services, Elizabeth L. Ray asked the TOC to develop a set of recommendations related to airport construction coordination and implementation that will support a more consistent, transparent planning process engaging the right stakeholders at the

right time and ensuring operational impacts are minimized and safety risk is managed to the extent practicable. (See Appendix A for the full tasking letter.) The task is intended to enhance the understanding of all stakeholders as it relates to the role they play in delivering a well-planned, coordinated and safe construction project. This report serves as the TOC's response to the FAA's task request on Airport Construction.

Task and Approach

The FAA's Tasking Letter to the TOC requested recommendations in the following areas, intended to capture expressed shortfalls in the airport construction lifecycle:

1. Review select past airport construction projects and associated data and identify lessons learned and recommend best practices for future projects. This would include the review of available safety and efficiency data where construction issues were noted as a factor. Please recommend a mechanism to ensure we capture and share lessons learned from future projects .
2. Identify and evaluate current strategic planning initiatives/tools used by FAA stakeholders at the Headquarter, Service Area/Region, and Service Delivery Point levels and provide recommendations on a best approach.
3. Assess the use of agency orders, advisory circulars, and internal processes currently being used to guide airport sponsors in their management of airport operations during construction and provide recommendations on a best approach.
4. Identity all stakeholders internal and external to the FAA needed and define their roles in the coordination and implementation processes.
5. Describe needed outreach strategies associated with each stakeholder and include a recommended timeline for outreach for major, long term projects.
6. Identify a set of recommendations on how safety risk should be better managed for aircraft operations impacted by airport construction projects.

In response, the TOC leadership established the Airport Construction Task Group, representative of the broader aviation community, which developed and agreed upon the following general approach to adequately address the issues identified within the tasking:

- Compile broad team of subject matter experts (SME) impacted by or have natural involvement in airport construction, including airport operators; flight operators; technical, analytical and operational units within the FAA, including the Airport Construction Advisory Council (ACAC); as well as other key constituencies such as the National Air Traffic Controllers Association (NATCA) and the Airline Pilots Association (ALPA). The full set of participants are included in Appendix B.
- Conduct SME interviews to gather perspectives of stakeholders on gaps in the construction process.
- Study variety of case studies (recent projects) to further understand gaps in construction process.
- Develop and document recommendations and solutions based on gaps and insights gained.

Executive Summary

Airport construction is critical to maintaining, improving and modernizing the National Airspace System (NAS). Airport construction involves numerous stakeholders in the NAS, making the process very complex. Participants in construction planning and execution come from multiple offices within airport operators, the FAA and flight operators. The aviation industry has experienced a number of challenges with airport construction and the RTCA Tactical Operations Committee was tasked to provide a series of recommendations to improve the process of airport construction.

Three major challenges were identified for airport construction. These challenges, or gaps, include maintaining awareness of all planned construction at airports outside of the Core 30, consistent planning of complex construction projects and consistent execution of construction. Each of these gaps is discussed in detail in this report, including relevant case studies and recommendations.

For the gap *Awareness of planned construction at airports outside of the Core 30*, case studies are presented in which flight operators became aware of planned construction only days to weeks ahead of the start of construction. Such scenarios may have significant operational impact on operators, including rebasing aircraft or restricting the number of seats sold on revenue flights. In each case study, there were organizations at the airport operator, within the FAA, or even at some flight operators that were aware of the planned construction many months to years in advance. However, information on the project did not disseminate broadly out to the aviation community. This report recommends establishing a Construction Clearinghouse, or database, which will ingest planned construction information from multiple sources and make this information available to the aviation industry. The Clearinghouse would require multiple input sources to avoid single points of failure as well as sound quality control of the underlying data.

For the gap *Consistent Planning of Complex Construction*, case studies presented in the report highlight the inconsistent experience of planning complex construction throughout the NAS. Some are well coordinated between stakeholder while others lacked in certain areas. Complex construction projects are those at some of the largest airports in the NAS as well as some at smaller airports that are particularly difficult, such as projects in which taxiways are temporarily converted to runways while a runway is closed for reconstruction. Existing templates and checklists for airport construction should be enhanced and integrated to guide a consistent process for such complex projects, and such templates should be continuosly improved upon based on experience from previous projects.

Additionally, processes are required to identify which project are particularly complex, and these projects should be regularly brief these to industry, starting as early as 24 months prior to construction. Ultimately a core leadership team made up of key stakeholders including the airport operator, FAA Air Traffic Manager, FAA Technical operations and flight operators, is necessary to drive coordination between stakeholders. The FAA also needs an entity that centrally owns, manages and improves templates and guides teams leading complex projects on best practices.

For the gap *Repeatable Construction Execution*, multiple challenges associated with Instrument Flight Procedures in context of airport construction are discussed. In order to develop or amend procedures for use during or after construction, accurate and timely data, including the airport survey and obstacle

information, is required. However, aligning required data with the development process is a consistent challenge in the NAS, and procedures which are otherwise ready are often unavailable (via NOTAM) until data alignment is achieved. For temporary obstructions, such as cranes, processes that drive publication of NOTAMs about the impact of obstructions on IFPs are different for on-airport and off-airport obstuctions. These processes require alignment. Utilizing technology or process to enhance knowledge of the status of obstructions and their impacts on IFPs may help minimize the operational impact of construction on flight procedures. The Crane Tracker is one particular tool that has offered valuable information on obstruction status and impact, and it should be funded going forward. Finally, there are numerous challenges associated with off-airport construction that are highly complex and go beyond the scope of this effort. A new Working Group is recommended to advise on managing the impacts of off-airport construction.

During Construction Execution, provision of timely and robust information on construction status to operators is critical. Status information includes both the NOTAMs that include obstacle location and impacts as well as ongoing construction progress and schedule. There are multiple opportunities to enhance such information, including publishing additional information in NOTAMs about detail that already exists on obstacle location, providing draft NOTAM information earlier, standardizing construction schedule status information and making information updates real-time.

In addition to the gaps reviewed above, recommendations related to safety during airport construction are presented. System safety during construction would improve by providing visual notification to both pilots and controllers of what changes to expect during construction. This may be achieved through simulation for controllers and as well as visualization of impacts to pilots via publications or EFBs. Additionally, there are challenges, noted above, around aligning airport and obstacle data with publications and procedures. Any inconsistency can create confusion for flight operators, and recommendations are provided to reduce the chance for such inconsistency either through increased frequency of publication or provision of clearer, more detailed NOTAMs that advise on what resources are unavailable. Finally, the process of establishing and executing Safety Risk Management Panels may be improved, including ensuring appropriate participation and improving accessibility to the panels for participants.

To improve construction in the NAS, the FAA needs to identify a single entity for NAS-level coordination of construction. Responsibilities at the NAS level include development and management of a clearinghouse, determining which projects are complex, development and maintenance of a construction management template and providing guidance to projects throughout the NAS. The Airport Construction Advisory Council (ACAC) has made progress on many of these issues since its formation, and the ACAC should be evaluated as a model for and potential owner of these NAS-level responsibilities.

Additionally, successful airport construction projects for all stakeholders requires a consistent leadership team for airport projects at a local level. A committed leadership team comprised of key stakeholders such as, but not limited to, the airport owner, the Air Traffic Manager, FAA Technical Operations and flight operators, is necessary to ensure coordination throughout a project's lifecycle.

Key Assumptions

- The Task Group focused on planned construction and not emergency repairs. Emergency repairs are unpredictable and thus out of scope of this effort.
- The Task Group focused on construction projects that affect airfield operations. Such work includes airfield projects (e.g., runway, taxiway, and apron construction, navigational aid or airfield lighting system projects) as well as some terminal construction projects that can affect the availability of aircraft parking postions or taxiing operations to reach these positions. It is noted, however, that the majority of projects impacting airfield operations are airside. Additionally, the group discussed off-airport construction, which may introduce obstacles that affect airport operations of flight procedures. Ultimately off-airport construction was deemed to be beyond the scope of this report (additional detail is provided later in this document).
- Although most on-airport construction projects are sponsored by the airport, they may also be sponsored by others, notably flight operators, the FAA, and third party facility operators (e.g., private cargo terminal developers, airline consortia, fixed base operators).

Overview of Airport Construction and Key Stakeholders

Numerous stakeholders are involved in the construction process. Careful planning, scheduling, and coordination of construction activities among stakeholders can minimize disruption of normal aircraft operations and avoid situations that compromise the airport's operational safety. Stakeholders need to understand how construction activities, scheduled interruptions to NAVAIDs, and aircraft operations affect one another to be able to develop an effective plan to complete the project.

Types of Construction Projects

Airport operators, the FAA, and occasionally airport tenants undertake a variety of construction projects that affect aircraft operations. Construction and infrastructure rehabilitation projects in airport movement areas[1]—which include new runway and taxiway construction and rehabilitation; airfield lighting and signage installation and upgrade; provision or enhancement of runway safety areas; and on-airport obstruction removal among other projects—are typically undertaken directly by the airport operator and their contractors. The FAA also undertakes construction projects in or adjacent to movement areas involving federally-owned and operated navigational aids, approach lighting systems, and other equipment. All of these projects can affect aircraft operations, safety, and airport capacity due to the closure or alteration of runways, taxiways, airfield lighting systems, or navigational aids while construction or rehabilitation activities are underway.

In non-movement areas, the airport or airport tenants--including airlines, fixed base operators, and third party developers—undertake a range of projects including aircraft parking apron construction and rehabilitation, taxi lane construction and rehabilitation, fueling system projects, lighting and utility

[1] The FAA defines "movement area" as "The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, *exclusive* of loading ramps and parking areas. At those airports with a tower, specific approval for entry onto the movement area must be obtained from ATC. By contrast "non-movement areas" are taxiways and aprons areas not under the control of air traffic.

projects, and terminal and support building construction and rehabilitation. All of these projects can result in changes to aircraft taxiing patterns, taxi lane as well as capacity constraints, particularly if apron/aircraft parking position projects limit airport gate capacity.

A final group of projects of interest to the Task Group are those that take place on airport property outside of the airfield environment but involve temporary obstructions such as cranes. These projects include the construction and expansion of airport terminals, parking garages, rental car facilities, roadways or transit ways, and air traffic control towers among others. As noted above, construction off airport involving temporary obstructions is outside of the scope of the Task Force's work.

Key Stakeholders in Construction

At a macro level, there are three primary stakeholders in construction: the airport operator, the FAA and the flight operators.[2]

Airport Operators

In the United States, almost all commercial service airports and many general aviation airports are owned and operated by local or state governments, independently incorporated public authorities, or multipurpose port authorities. These public entities are the most typical sponsors of construction on airports. The following diagram presents a notional overview of the key steps and timing involved in an airport operators' process for planning construction:

Figure 1 Airport Operator Timeline for Construction[3]

5 to 20 years in advance	3-5 years in advance	2-3 years in advance	1-3 years in advance	3-12 months in advance	3-6 months in advance
Airport Master Planning	Project Planning leading to decision to proceed with design	Environmental review	Design process	Finalize design, submit and receive approval for Constr. Safety Phasing Plan	Complete project bidding process

Airport operators typically develop master plans that address long term airport needs and have lead-times that range from 20 years to 5 years. These master plans are used as the basis for the development of airport capital improvement plans (CIPs) that identify specific construction projects planned in the near to mid-term future—typically over the next 5 years. CIPs typically include a brief description of the projects to be undertaken, the planned timeline for their construction/implementation, and anticipated project costs.

[2] There are a number of other stakeholders that may also need to be involved depending on the project including project contractors/designers and third-party developers. For brevity, these stakeholders and their responsibilities are not described in detail in this section.

[3] This is a generalized timeline that will vary depending on the complexity and magnitude of the project under consideration. It does not apply to unplanned of emergency construction projects, such as those that are undertaken in response to unanticipated infrastructure degradation or failure.

Project planning typically occurs about 3 to 5 years ahead of construction. This effort involves a high level assessment of the intended project, considering the anticipated costs as well as the benefits. Planning concludes with a decision to proceed with project design. Before construction design is initiated for a project, environmental reviews are typically required, and the environmental decision may impact scope or planned phasing of the project. Design of larger construction projects begins approximatley 18 to 24 months prior to construction.[4] This is the critical point in time that coordination with stakeholders should begin. Advisory Circular (AC) 150/5370-12, Quality Management for Federally Funded Airport Construction Projects, provides comprehensive guidance on safely managing construction projects from design through completion. Design is typically finalized between 3 and 6 months before construction begins.

A key component of project design includes development of a Construction Safety Phasing Plan (CSPP) which is a comprehensive safety management strategy that identifies and mitigates increased risk during construction activities on an active airfield. A CSPP, as described in AC 150/5370-2, Operational Safety on Airports During Construction, is required for federally funded projects, including those funded with Passenger Facility Charges (PFCs), and assists airport operators in complying with the provisions of Federal Aviation Regulation (FAR) Part 139, Certification of Airports. The CSPP is a tool used by the airport operator to identify, mitigate and manage the risks associated with a project to ensure a safe operational environment. A subset of the sections of the CSPP include the following:

- Phasing for the project
- Areas and Operations Affected by Construction Activity
- Navigation Aid (NAVAID) Protection
- Contractor Access
- Wildlife Management
- Foreign Object Debris (FOD) Management
- Hazardous Materials (HAZMAT) Management
- Runway and Taxiway Visual Aids
- Marking and Signs for Access Routes
- Hazard Marking, Lighting and Signing
- Protection of Runway and Taxiway Safety Areas

There is variability in the design process across different airport operators. Some have engineering and project management staff in house, while others outsource all design and related work. Airports may also have variations in staff experience with complex airfield projects and available resources. Finally, the flow of information about the project design may vary as well. Some information is proprietary in nature and may not be released until the project is more mature; this may be due to politics with the local community, funding or environmental issues.

[4] While approximate timelines are included in this report, in reality, every construction project is different and the timeline is an approximation. Additionally, these timelines are relevant for planned construction and not emergency or “pop-up” projects.

Once design is completed, airport operators schedule Pre-Bid meetings and make bid packages available to interested contractors. This typically occurs a few months ahead of construction. Variations in airport governance and/or regulatory structures may impact the bid and decision making process. Once the bid is awarded, a Pre-Construction meeting is held with stakeholders prior to the start of construction.

A key challenge for airport operators is the uncertainty and timing of funding for construction. Airports typically combine multiple funding streams together for construction projects, including FAA Airport Improvement Program (AIP) funding, local share, state share, etc. Any of the funding sources may or may not be available when the airport has finished design. The airport may have a project that is fully designed and available to be advertised for bid but lacks the funding necessary to award it, and result in the project to be placed on hold.

Another challenge for airport operators is the significant number of organizations and individuals involved in the planning process. Planning a construction project often involves the airport, consultants for design, project management, contractors, flight operators and multiple offices within the FAA. Airport leadership throughout the process is critical for a smooth and timely completion. Additionally, with the number of people involved across all stakeholders, projects may suffer from regular turnover in critical positions and new people coming into the construction process throughout the life cycle of the project. Keeping all stakeholders aware of the project plan and status is a significant challenge.

A third challenge is the fact that unexpected or new information about construction may emerge throughout the project. For example, new information about construction site conditions may be uncovered during the design or even construction phase and drive changes to the construction phasing. This risk reinforces the need for ongoing coordination amongst stakeholders.

FAA

The FAA has a number of different organizations that are involved with the planning and execution of airport construction.

FAA Office of Airports (ARP) develops advisory circulars (ACs) for airport sponsors to provide guidance and safety standards for managing airport construction projects and to ensure the safety of airport construction activities. AC 150/5370-2, Operational Safety on Airport during Construction, and AC 150/5370-12, Quality Management for Federally Funded Airport Construction Projects, provide comprehensive guidance on safely managing construction projects from design through completion. Scheduling a Pre-Design meeting with the affected stakeholders, as described in AC 150/5370-12, and early development and coordination of a Construction Safety Phasing Plan (CSPP), as described in AC 150/5370-2, ensure a safe, cost effective and operationally viable construction plan that minimizes the impacts on airfield operations. Some of the critical elements to be identified for an incident free construction project are the ability of the airport construction manager to properly coordinate, phase, identify affected movement areas, protect for navigation aids, and how to access construction area with minimum disruption to airport operations. ARP also provides guidance on wildlife management and preventing foreign object damage. Notification, inspection, maintenance of safety areas, marking,

lighting and protection to runways and taxiways during construction are all critical elements addressed in the CSPP to ensure the sponsor is prepared to address them properly.

The **Airport District Office (ADO)** staff collaborates with the sponsor's staff in both Pre-Design and Design/Phasing of construction. ADOs conduct early review and coordination of the CSPP among several internal and external stakeholders. It is advantageous for the airport operator to engage early with local FAA Air Traffic and Technical Operations staff to assess the magnitude of preparedness required to maintain smooth support by the FAA during construction. ADO staff carefully reviews CSPPs with Air Traffic subject matter experts to determine whether any phase of the construction may require a change from the normal day-to-day activity. The ADO monitors the sponsor's construction progress.

The Air Traffic Organization (ATO) has a vested interest and responsibility to assess the impact of all proposed NAS facility/service interruptions, and to provide system impact reports (SIRs), as required, with respect to NAVAID outages, runway or taxiway closures, or other losses of air traffic services. Multiple groups within the ATO are impacted by construction, including those that manage equipment, information and flight procedures as well as daily operations.

The **ATO Technical Operations Services** installs, maintains, modernizes, and operates NAS systems and services used for Air Traffic Control. Technical Operations utilizes a Strategic Event Coordination (SEC) application to manage scheduled interruptions of ATO NAS equipment over 24 hours in duration as a result of airport-sponsored or Technical Operations initiated projects. The SEC application is utilized for final tactical coordination by multiple FAA organizations for performing risk assessments, identifying affected instrument flight procedures, issuing Notices to Airmen (NOTAM), coordinating flight inspections, and developing system impact reports within 30 days of the project start date.

Aeronautical Information Services (AIS) collects, validates, stores and maintains aeronautical data for the U.S and its territories. AIS develops and maintains all public Instrument Flight Procedures and airways. AIS serves as the FAA's aeronautical charting authority for the development, publication, and dissemination of aeronautical charts and products to support aviation and to meet demand for increased capacity, efficiency, and predictability in the airspace, routes, and airports of the NAS. Airport construction changes have a high potential to affect aeronautical data and procedures. Timely notification and planning are needed to allow for amended and new procedures to be delivered on time.

The **Airport Construction Advisory Council (ACAC)** is dedicated to ensuring the safety of all stakeholders operating in the NAS during all runway and taxiway construction projects. The ACAC is tasked with developing strategies and risk mitigations for Air Traffic Managers (ATMs) to employ. These strategies enhance surface safety and ensure that communication is complete and consistent. The ACAC serves as a conduit for sharing good operating practices among managers throughout the NAS. The ACAC is responsible for transforming appropriate strategies and best practices into future Air Traffic Organization policy to perpetuate operational safety during all construction projects. The ACAC supports collaboration between the FAA and Airport Operators, and all other stakeholders. The ACAC and System Operations Services (AJR) work in parallel with each other to support airport construction and efficiency, sharing information, tools and initiatives. Core members include individuals from Runway Safety, Air

Traffic Managers from each of the Service Areas and Alaska, Flight Standards, System Operations and FAA Airports.

System Operations Services (AJR) is the focal point for stakeholder interaction through periodic national and regional customer engagement opportunities and serves as the FAA's Customer Advocate. AJR facilitates strategic planning for upcoming construction projects. System Operations, Performance Analysis, and Surface Efficiency work together with both FAA and other stakeholders on these projects. There are six Deputy Directors of System Operations (DDSOs) located in each of the three service centers that work closely with their associated ATC facilities. AJR performs fast-time simulation modeling and analysis to quantify the impacts of construction on multiple key operational metrics (throughput, taxi out and taxi in times). Results serve to assess the benefits of alternative project phasing and other proposed procedural mitigations developed to mitigate the impact and improve efficiency and decrease surface congestion. The results can be used to inform all stakeholders of expected arrival and departure rates under varying wind and weather conditions and to provide the basis for schedule negotiations with air carriers (if needed). The results of the modeling and analysis are communicated at airport or FAA sponsored customer focus meetings, and are used to develop SIRs.

The **Flight Procedures Team (FPT)** evaluates and plans any required flight procedure changes dictated by NAVAID outages or runway layout changes (temporary or permanent). They also initiate development of new or alternate procedures when requested by Air Traffic or others, or when dictated by changes associated with the construction project. The Flight Procedures team coordinates with Aeronautical Information Services to issue Procedural NOTAMs if required and provides an estimated procedure completion date which may include flight inspection.

The **Operations Support Group (OSG)** is responsible for coordinating with the appropriate Traffic Management Officer(s) (TMOs) for the affected ATC facilities to provide an organizational response. When requested by ATC facilities, the OSG coordinates with Flight Procedures Team for alternate procedures. The OSG requests System Impact Report (SIR) information and indicates concurrence from Terminal, En Route, and System Operations for each strategic event, as required, and submits the SIR information to the Air Traffic Control System Command Center (ATCSCC) for national coordination and dissemination to the customers. These SIRs include input from the TMOs and Terminal and En Route specialists at the facilities indicating the impact the interruption will have on the NAS and ensure local coordination with customers. For runway type construction projects, Technical Operations support is critical for timely installation, flight inspection and commissioning of navigational equipment.

Service Center **NAS Planning Integration (NPI) Teams** within the Planning and Requirements (P&R) Groups provide project and construction briefings to other Air Traffic Organization units on any airport project/activities that impact NAS facilities. Additionally, they provide information on services or results in an airport runway closure (full or partial) and/or significant taxiway closures. NPI teams get involved early in the construction process to understand impacts such as shutdown of equipment, pavement closures and associated integration opportunities. These teams pursue ongoing relationships with airport operators and ADOs, acting as a liaison to FAA's efforts to improve NAS equipment and maintain service availability. When airport construction has an impact to FAA facilities (localizers, approach

lighting systems, etc.), NPI develops reimbursable agreements. These agreements document and fund any needed FAA facility work and ensure the facility is protected, modified or relocated as necessary during construction.

Flight Operators

Airport construction impacts all types of flight operators throughout the NAS. Major projects that have been coordinated and discussed with operators early in the design process have proven to be successful, and least intrusive to airport operations and the traveling public. The operator needs to know when construction will be occurring, what facilities will be affected, what the expected capacity and other operational impacts will be, and what safety measures will be put in place while construction is in progress. Examples of specific flight operator concerns include:

- Efficiency: Will flight times be affected? Will Traffic Management Initiatives (TMIs) be necessary to manage demand? Will runways or taxiways be affected? Will taxi in/out times be significantly impacted?
- Safety: Which NAVAIDs will be lost? Is runway length reduced? Are there new obstructions to be considered when computing takeoff or landing performance?
- Capacity: Will a schedule reduction (or slot allocations where applicable) be necessary due to a loss of NAVAIDs, reduced runway availability, or reduced runway length? Can a different aircraft type be used to accommodate the changes that are needed? Do those aircraft resources exist in the operator's fleet? Is there adequate lead-time to make these changes? Are crew resources available and flexible enough to make these changes? (Note, fleet changes that will be in effect for a month or more require a significantly longer planning horizon.)
- Rebasing Aircraft: Will the construction impact access or facilities at an airport where general or business aviation aircraft are based thereby limiting operations? (Note, most general and business aviation aircraft rely on specific airports to base aircraft).

Commercial flight operators have Corporate Real Estate (CRE) departments that generally become aware of construction first at an airport. Typically, operator CRE representatives are intimately involved in planning and financial activities at FAR Part 139 airports. As a consequence, they usually have the earliest visibility into future airfield construction. Local operator station management also regularly interacts with the airport and may get early advice of upcoming construction, particularly if it will directly impact the operator's leasehold. At large hubs, flight operators tend to obtain the best information about construction work. For projects where communication and the working relationships are strong, engagement with the flight operators occurs early. Ideally, and as recommended in AC 150/5370-12, the operators will have an opportunity to provide input to the airport operator early in the design process and well before bid documents for a project are completed. Development of the CSPP also presents another opportunity during the design process where flight operator input should be obtained. This engagement tends to occur more frequently at the Core 30 airports.

Flight operators have many groups within Network Planning that evaluate the impacts of construction and other operational factors on published schedules. This evaluation can occur as early as one year or more before departure. While the operator would like notification of potentially negative effects as

soon as possible, a final understanding of any major external impacts on future schedules is required approximately 18 to 24 months beforehand at a large hub and six months before the start of construction at second tier stations and smaller. Generally speaking, the flight operator can still make final corrections to schedules, such as schedule reductions, fleet type changes, or block time adjustments, three to six months before the activity. Anything closer in than 100 days becomes more challenging for the operator to adjust as seats for sale, aircraft routing and maintenance requirements and flight crew pairings are being finalized. The diagram below depicts the sequence of events for schedule development at one major commercial airline.

Figure 2 Commercial Airline Schedule Development Timeline

During engineering design, other departments within the flight operator will also evaluate the effects of a construction project and its impacts on the airport and flight operations. Performance engineering evaluates the impact of construction on payload and range with a focus on whether runway closures or reductions to available runway length limit the seats that can be sold or the ability to operate non-stop to the planned destinations under all wind and weather conditions. They also evaluate whether there are better aircraft available to serve the market while construction is in progress. In some cases, airport operators have made specific requests to airline Performance Engineering groups to assess the impacts of project alternatives to minimize the adverse effects on the operators and traveling public. This occurred frequently during the design of projects required to comply with the runway safety area mandate.

Pilot groups also evaluate the impacts of expected construction and develop training and educational materials for pilots who will ultimately operate on the airport in close proximity to active construction areas. This will frequently include publication of special airport diagrams identifying construction areas and any special procedures developed to enhance safety during the project. Finally, with the advent of Safety Management Systems within the operator community, multiple elements of a construction project may be subject to formal safety review to ensure any known risks are mitigated to acceptable levels from the operator's perspective.

During the construction event, many of the same parties remain involved, including flight operations, flight dispatch, passenger services and station/hub management. These parties manage daily flight operations in the face of the construction and work to mitigate on-going operational impacts.

Summary of Stakeholder Overview

The table below depicts different organizations within each of these stakeholders that play a role in airport construction:

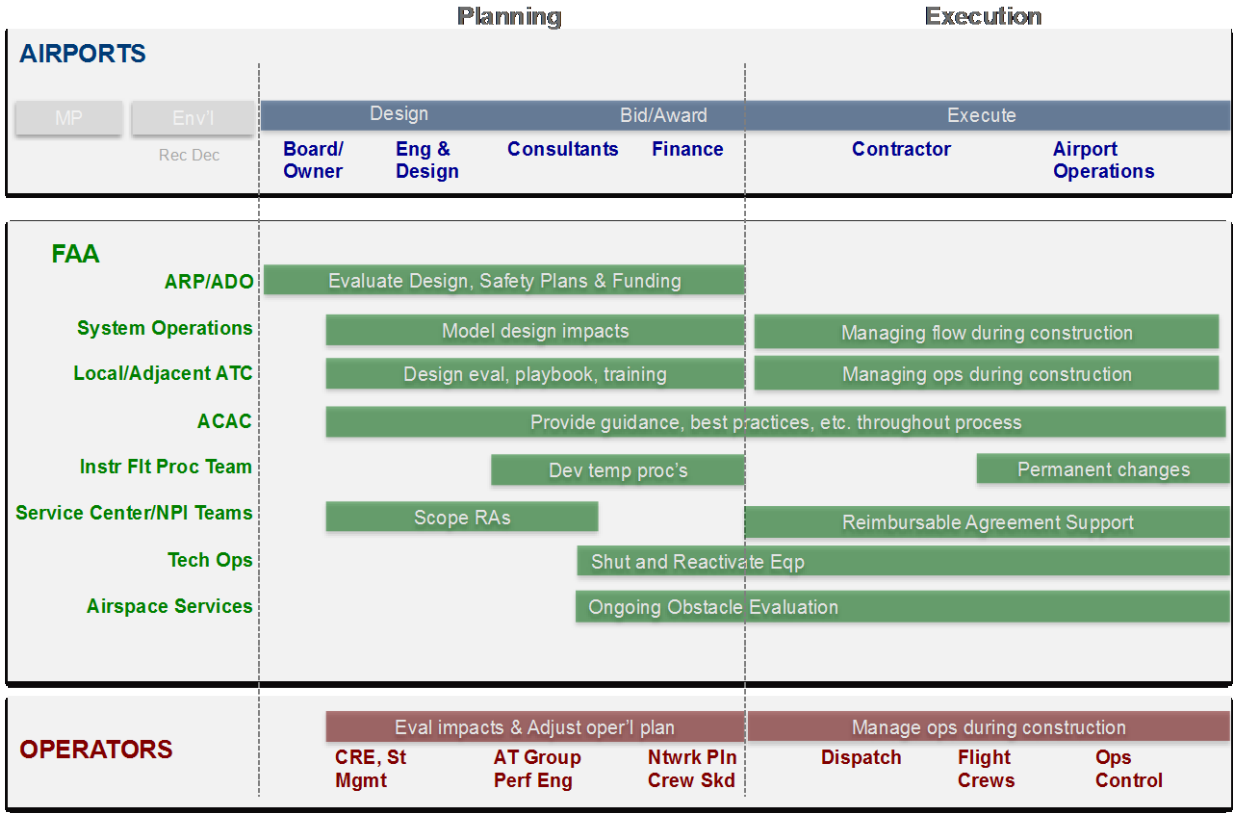
Stakeholder	Organizations that Participate in Airport Construction
Airport Operators	• Airport owner/municipality • Finance • Engineering and Designers • Consultants • Contractor • Airport operations

Federal Avaition Administration	• Airports Organization & Airport District Offices
	• Air Traffic Organization
	  o Aeronautical Information Services
	  o System Operations Services
	  ▪ Performance Analysis
	  ▪ Slot Administration
	  o Local/Adjacent ATC
	  o Airport Construction Advisory Council
	  o Tech Ops / Engineering Services
	  o Service Center
	  ▪ Flight Procedures Teams
	  ▪ Operations Support Groups
	  ▪ NAS Planning and Integration Teams

Flight Operators	• Corporate real estate • Station management • Air Traffic group • Performance engineering • Network planning • Crew scheduling • Flight crews • Flight dispatch • Operations control

The following graphic depicts a generic construction process and where and when different stakeholders generally participate in the construction process.

Figure 3 Generic Construction Process



Recommendation 1. Develop training materials and/or videos that provide education around the different stakeholder perspectives and processes involved in airport construction.

Airport construction involves numerous stakeholders interacting over an extended timeline. Few of these stakeholders hold deep knowledge of the issues that motivate the actions and priorities of the other stakeholders. Additionally, with potentially long timelines for construction efforts, it is likely some stakeholders will have changes in the individual personnel involved in airport construction. All individuals participating in airport construction would benefit from available or additional enhanced training materials that provide insights on the different participants, their perspectives and the processes involved with airport construction planning and execution.

Critical Gaps and Recommendations in Airport Construction

After examination of a series of case studies related to airport construction, three major gaps were identified for airport construction. The three areas are:

1. Awareness of Planned Construction
2. Consistent Planning of Complex Construction Projects
3. Consistent Construction Execution

These are summarized in the following figure and described in further detail in the sections below (along with the relevant case studies):

Figure 4 Summary of Key Gaps in Airport Construction

Key Gap →	Awareness of Planned Construction	Consistent Planning of Complex Construction Projects	Consistent Execution of Construction
Issues	Information about planned construction at smaller airports can "slip through the cracks"	Planning for complex construction, generally at the largest airports, does not follow a standard template and the process may be 'reinvented' each time	Maximum available capacity at airport during construction is not always available; also completion of construction not always synchronized with efforts to ensure resources are available to operators at the conclusion of construction
Applicability	Primarily airports outside of the FAA's Core 30 Airports[5]	Applicable to construction at most Core 30 airports in NAS as well as highly complex projects outside of the Core 30 airports	Applicable to all construction projects
Need	Need reliable, centralized information flow on construction effort and status at least 6 months ahead of construction	Need consistent, repeatable engagement process across all stakeholders planning a complex project	Need consistent, repeatable engagement process across all stakeholders during execution

Awareness of Planned Construction

Background and Motivation

Three case studies are presented to demonstrate the challenges associated with maintaining stakeholder awareness of construction projects at airports other the Core 30 large hub commercial service airports. These "second tier" facilities include the 484 commercial service airports classified as medium hubs, small hubs, non-hubs, or non-primary commercial service airports, as well as general aviation airports with substantive business aviation use in the National Plan of Integrated Airport Systems (NPIAS). Outside of the Core 30 large hub airports, there is less frequent or consistent interaction between the airport sponsor and airlines/general aviation operators, so lack of awareness of upcoming construction projects has been a recurring issue, as demonstrated in the following case studies.

[5] Definitions of airport groupings are included in Appendix C.

Case Study: Daytime Construction on Longest Runway at Small Hub Airport

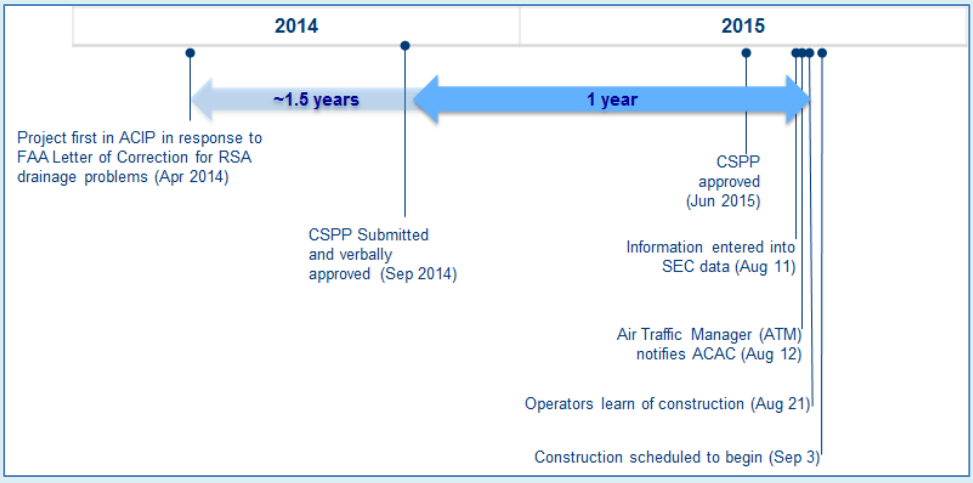
A commercial service airport, classified as a "Small Hub" in the FAA's NPIAS, initiated construction on its longest runway in the third quarter of 2015. The construction was done in response to a finding from an FAA Letter of Correction in April 2014 that the Runway Safety Area had a drainage problem. The Airport Operator originally added the project to its Capital Improvement Plan in April 2014 and submitted a Construction Safety and Phasing Plan in September 2014. However, grant funding did not become available until late 2014 to the airport, so the project was put on hold. In June 2015, the CSPP was approved and in mid-August 2015, flight operators learned that construction was to begin in early September.

The construction was during the daytime on the longest runway at the airport, so flight operators had to restrict payload on their aircraft operating into this airport to accommodate operations on the secondary runway. One flight operator using 50-seat regional jets had to block 16 seats from sale during construction. Blocking seats reduces revenue opportunity for commercial operators, and the revenue impact is exacerbated by the fact that passenger fares purchased closer to the day of travel tend to be the highest fares. Additionally, some operators had to inconvenience customers who had already purchased tickets on the flights for which seat caps became applicable. This resulted in a service delivery failure and the need for re-accommodation and compensation.

With only two to three weeks of notice on the construction, flight operators were unable to make meaningful changes to their flight schedules to respond to the construction event. One operator indicated that with only a few more weeks' notice, they would have scheduled a different aircraft type into this airport. The alternative fleet type has improved performance characteristics and could have operated into this airport without seat restrictions, even on the secondary runway.

A timeline of events associated with construction at this airport are presented in the graphic below. Note that prior to August/September 2015, certain parties were aware of the construction event but that information about the construction did not permeate out to the broader stakeholder community.

Figure 5 Timeline of Case Study of Awareness of Runway Construction at Small Hub Airport

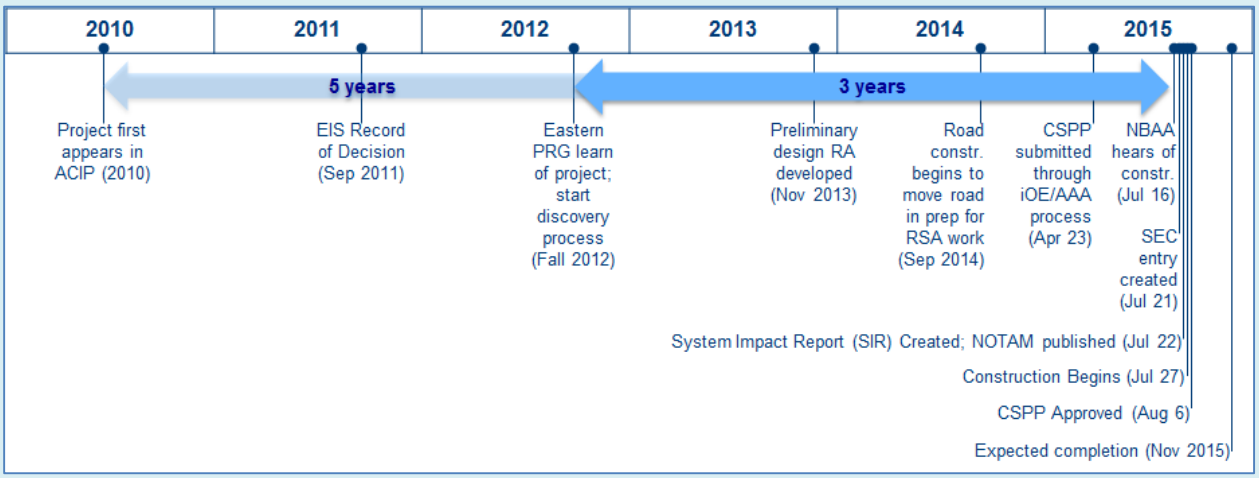


Case Study: Runway Reconstruction at Primary Runway at National GA Airport

A "National GA" Airport, as classified in the FAA NPIAS, initiated construction on its longest runway in the third quarter of 2015. In this case study, business aviation operators were primarily impacted. This operational community became aware in mid-July 2015 that construction was planned to begin on July 27, 2015. Business aviation operators with aircraft based at this airport were forced to temporarily re-base aircraft during this construction and had only a 10 day notice to identify alternative locations.

The full timeline of events associated with this construction is depicted below. Note in this case that there were multiple stakeholders who were aware of this intended construction years in advance, but the information did not flow through to the impacted operators until approximately 10 days prior to the start of construction.

Figure 6 Timeline of Case Study of Awareness of Runway Construction at National GA Airport



Case Study: Temporary Taxiway Conversion at Small Hub Commercial Service

Finally, a Small Hub Commercial service airport began runway construction in November 2015. This construction involved temporary conversion of a taxiway into a runway. Different air carriers became aware of the details of this construction at different times. One large carrier was aware of the construction in July 2015 and had begun internal coordination from that time, including dedicating special aircraft to this airport in its schedules. Other large carriers became aware of this construction only one week before construction began. This case study highlights the fact that with no central data source on construction, different industry stakeholders can have very different levels of awareness on the same project.

Observations from Case Studies

These case studies demonstrate that even when many individual stakeholders are aware and involved with planning airport construction, information does not always flow out to the broad operator community that needs to plan schedules and mitigations during construction. Mitigations may include rebasing aircraft, changing fleet types, schedule times, increasing flight block time, reducing schedules, or in a worst case scenario, reducing payload, that is, blocking seats or restricting cargo.

Early and frequent communication between the airport and flight operators is a critical component to enable this flow of information. When an operator has a large operational presence at an airport, regular communication channels are well established and robust and may occur through multiple operator units such as Corporate Real Estate, airline ATC managers, local station management, or chief pilots. The small airport environment, however, is a challenge as there is less daily communication between the flight operators' central operations and the local airport station personnel. In addition, local station management may be from an affiliated regional carrier and not tied directly to the larger operator's headquarters. For commercial operators, the station manager may learn of potential projects from the airport but not necessarily be aware of the need to pass this information back to headquarters organizations such as network planning. This is a critical path in the communication of such projects. Flight operators recognize that better training of its internal staff on best practices for reporting construction projects is a key area of improvement, however this mechanism should not be the sole means of communicating and coordinating the planning for airport construction projects.[6]

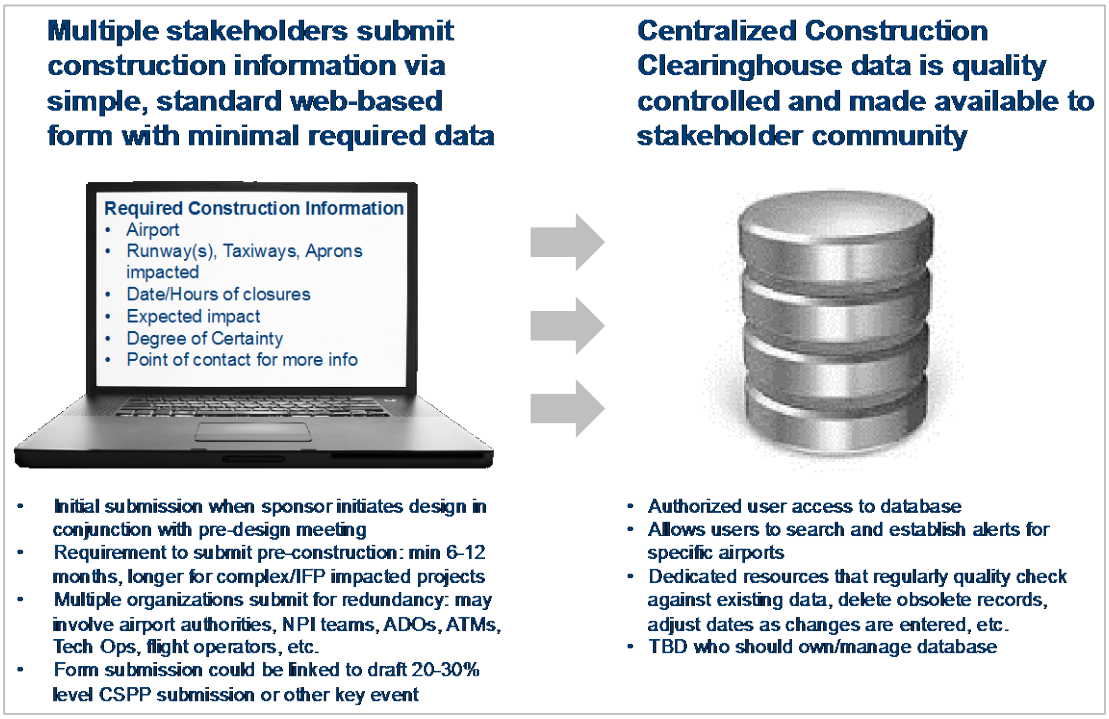
Today in the NAS there is no one standard for notification of flight operators about construction. This means flight operators may be unaware of planned construction, and most probably have not had an opportunity to participate in the project design. Even when aware, the operators may not know the specifics of the timing and potential impacts. The issue is most relevant for airports outside of the Core 30, which tend to have monthly or quarterly construction working groups that meet to review future projects.

Construction Clearinghouse Concept

There is a need in today's NAS for standardization related to construction planning and notification. A potential solution would be a construction clearinghouse accessible to various stakeholders with information available at various levels of granularity depending on the particular need or involvement of the stakeholder. Project initialization within the clearinghouse would "send up a flare" that construction is being planned for an airport. This should alert interested parties in the aviation community to engage to learn more about what construction is being planned and what level of involvement is appropriate. The following diagram depicts the clearinghouse concept:

[6] Additionally, flight operators also recognize the opportunity to adjust future lease agreements with airports to include requirements for notification of construction. Operators are considering working with their trade associations (A4A, IATA) to institutionalize such an approach.

Figure 7 Construction Clearinghouse Concept



The following key tenets are necessary for a successful clearinghouse concept:

- Keep the required data to populate the Clearinghouse to a minimum to make it as quick and simple as possible for submission;
- Information should be submitted by the project sponsor before the start of engineering design in conjunction with the schedulng of project pre-design meeting to allow meaningful engagement during the design process by interested stakeholders;
- Ensure information on project phasing is posted to the clearinghouse at least six months ahead of construction to enable flight operators to plan mitigations; for projects that require any procedural changes, ensure information is populated at least 18 months ahead of construction. Additionally, the draft CSPP should be entered with an associated web link or point of contact;
- Allow multiple stakeholders to submit entries into a clearinghouse to avoid a single point of failure on the flow of information;
- Use the best source of information available for construction project planning and coordination; in most cases the project sponsor or representative design engineering consultants should always be the first choice as the underlying source of information;
- Identify an entity in the FAA that would accept inputs and provide oversight and quality control for the clearinghouse, validation, avoid duplicate records, delete outdated records, etc;
- Maintain valid and accurate contact lists for the airports and other entities planning construction. The intent of the data is to “send up a flare” about intended construction and provide points of contact to obtain more detailed information about projects. Project sponsors also struggle with maintaining valid contact lists for operators. A Clearinghouse would derive

additional value if interested operators had a mechanism to provide contact information to project owners as it pertains to specific projects. The challenge for all contact lists is to ensure they remain current and do not become stale.

The TOC recognizes that a Clearinghouse would not provide 100% awareness of all construction project scenarios . There are historical examples, such as stimulus funding during the Great Recession or last minute grant funding, in which "shelf"[7] projects may be moved from standby to active status by the project sponsor in a short time frame. However, in this scenario, the clearinghouse still supports the concept of communicating the plan, duration and impact of the project during the design process so that general awareness and continuing follow up can occur and notification of start of actual construction occurs as soon as practical. The goal of the clearinghouse is to capture the majority of construction work and provide a single point of reliable information to relevant stakeholders.

Promising Information Sources for Airport Construction

As noted in the case studies above, different stakeholders have information on construction at different times. In these examples, information on construction was known to "somebody" months or years in advance of the project. After examination of the case studes, the following promising information sources were identified for construction information. The TOC anticipates a successful clearinghouse concept could be enacted if and when multiple stakeholders from the following list (or beyond this list) are submitting construction information. Note that the ACIP would be an excellent source of information but neither the FAA's version nor the airports' versions are expected to be made available to a clearinghouse.

Figure 8 Promising Information Sources for Construction Clearinghouse

Information Source	Type of Data
Airport Operators	• Provides the best source of information when the Airport Operator is the sponsor of the project
NAS Planning and Integration Teams in FAA Service Areas	• Gathers airport development plans, construction schedules and surface outage information to distribute within FAA • Determines impacts of construction projects to FAA facilities and leads development of mitigation plans • Has reliable information based on communication, network and frequent meetings with Airport Operators, State Aviation Departments and ADOs; information currently managed within NPI teams in spreadsheets • Establishes Reimbursable Agreements when appropriate; ideally done 6-9 months in advance of construction
Airport District Offices	• Maintains close working relationship with Airport Authorities

[7] A "shelf" project is one in which the contracting authority has done much of the preparatory work for the project and the project is placed "on the shelf" until funding is made available. As presented in one of the case studies, a project may remain on the shelf for more than a years' time (or more) before funding is available.

	• Evaluates early drafts of CSPP so have earliest indication within FAA of upcoming construction
Air Traffic Managers	• Informs the Airport Construction Advisory Council about any expected airport construction, as required by FAA Order 7210.3 • Maintains close working relationships with local airport staff so another promising source that is close to the sponsor of the project
Technical Operations/SEC Database	• Receives SEC coordination form informing Tech Ops about timing needed to shut down equipment associated with airport construction • Current requirement is 30-45 days but many submissions occur much earlier than the required time. The SEC process is in its first few years of maturity and data from 2015 suggests that already approximately ¼ of all submissions were made ahead of the 45 day deadline.
OE/AAA Website	• Provides Construction Safety Phasing Plans as well as obstacle evaluations.
Airport Construction Advisory Council	• Receives notification from Air Traffic Managers and other industry stakeholders about construction and compiles into a living document about future construction.
FAA Corporate Workplan	• Provides NAS-level information that both informs and is informed by the Clearinghouse

Recommendations for Awareness of Airport Construction

Recommendation 2. Develop a notification process and clearinghouse for intended construction.

The clearinghouse concept, detailed above, should be implemented as a web portal requiring a minimal set of information. Most construction would be reported initially between 18-24 months before actual start of construction during engineering design, but no later than 6-12 months in advance of construction when final phasing has been established and the project is ready for bid. While operators are capable of adjusting schedules closer in than 6 months, the 6-12 month notification window allows operators to integrate construction information into their existing planning cycles. Projects that drive changes to instrument flight procedures and more complex projects require 2 years' advance notice at the start of design to allow stakeholder engagement and the development of impact mitigation strategies.

The notification process may require project sponsors to submit the information when the CSPP is at 20-30% maturity, which is the stage sponsors already provide early CSPP submissions as stated in AC 150/5370-2. As not all construction projects require a CSPP, consideration must be given as to how to ensure all sponsors reliably submit information into a clearinghouse.

A NAS-wide clearinghouse is a significant effort. To more easily roll out a portal, the FAA may consider staged implemention. The TOC recognizes that rolling out a new database is a complex and challenging endeavor and it takes time for such systems to "ramp up". Both the FAA and aviation stakeholder community at large should exercise patience for a clearinghouse to become successful.

Ultimately, the vision of such a clearinghouse is to be a "one stop shop" that includes all relevant information about construction – from planning through execution as well as post-construction analysis to measure success and understand lessons learned. This may eventually include construction plans, construction notice diagrams, updated calendars for complex projects, etc. However, the vision of a one stop shop should not impede progress on a portal that includes basic construction planning awareness information as a first step.

Recommendation 3.	**Have multiple sources of submission into a construction information clearinghouse.**

There is high variability in the size, resources and experience among airport operators as well as flight operator personnel working at airports. Given this variability, there is risk of single points of failure in the flow of construction information. Permitting and encouraging multiple submitters into the clearinghouse will serve to mitigate this risk. As noted above, there are multiple engaged stakeholders that could enter relevant data into a clearinghouse, including the project sponsor, sponsor's consulting engineers, local ATM, ACAC, NPI teams, ADOs, Tech Ops, etc.

Recommendation 4.	**Define one organization within the FAA to establish and manage a construction clearinghouse.**

The clearinghouse will be successful only if a central entity manages the quality of the data, including removal of duplicate records, removal of stale records and entry of new data. While the FAA will make the final determination of which entity owns the clearinghouse, the TOC suggests the FAA give consideration at a minimum to ARP, supported by individual ADOs, ATCSCC, the Airport Construction Advisory Council, the Tech Ops/SEC team and the NPI teams as possible central owners of the data. These parties are suggested for consideration as today they play important roles in airport construction.

Additionally, the entity managing the Clearinghouse should involve industry participants such as National Business Aviation Association (NBAA), Aircraft Owners and Pilots Association (AOPA), Airport Council International – North America (ACI-NA), American Association of Airport Executives (AAAE), National Association of State Aviation Officials (NASAO), Airlines 4 America (A4A), International Air Transport Association (IATA) and others to assist in informing and quality checking the data.

Recommendation 5.	**Make construction portal information accessible to any user authorized through password protection.**

The clearinghouse may be housed under the faa.gov domain for ease of access of the information and should include training modules to understand the information. All authorized users should be able to sign up for updates and alerts, via email, for specific airports and projects.

Recommendation 6.	**Develop a one page "desk reference" or check list for airport operators to understand their full suite of reporting requirements.**

A desk reference or check list is intended to provide an easily understood and straight-forward overview of all required and recommended airport reporting requirements. It could be used to emphasize

outreach and coordination responsibilities and associated points of contact. Having a simple, comprehensive guidance document that describes required reporting and outreach should assist all airports. It would be particularly helpful with identifying long lead time items like instrument flight procedures that can have lead times of 18 months or more and require close coordination with construction activities to ensure no loss of instrument capability when the project is finished.

Recommendation 7.	**Engage key airport trade organizations such as ACI-NA, AAAE and NASAO to collectively develop educational materials and help roll out any new process improvements to the airport operator and consulting community.**

Consistent Planning of Complex Construction

Background and Motivation

The NAS has experienced a number of highly complex construction projects at the core 30 airports over the last decade. This has included full runway rehabilitation projects at JFK and EWR, runway safety area projects at SFO and LAX, and opening new runways at ORD and Fort Lauderdale–Hollywood International Airport (FLL). There have also been complex projects at other airports with single runways where the runway was closed for reconstruction and a parallel taxiway was converted to a temporary runway. These included Palm Springs International Airport (PSP), Juneau International Airport (JNU), Asheville Regional Airport (AVL) and Quad City International Airport (MLI).

Over the last ten years, the industry has been moving in a positive direction in terms of collaboration among the different stakeholders in planning such complex projects. Although existing FAA Orders and Advisory Circulars provide guidance to airport operators to ensure the highest level of safety, there is room to grow, and there is still no template or comprehensive guidance on how to execute complex construction planning in a consistent and repeatable format. Such guidance should include definition of necessary participants and their roles in construction planning.

The following case studies present some of the challenges and successes experienced during recent complex construction projects:

Case Study: Runway Construction at Large Hub East Coast Airport

Planning for the runway reconstruction, which included the airport operator, several FAA lines of business and operational stakeholders was initiated almost 3 years prior to the start of construction. The project's key challenge was the absence of a defined leader of the process across stakeholder groups. With no single point of leadership, stakeholders lacked understanding of the status of different aspects of the project. In one example, stakeholders felt that modeling of airport capacity and delay and associated arrival and departure rates started many months later than ideal. Communication to the stakeholders about the status of the project and related modeling was included as a recurring agenda item during regularly scheduled metro area delay reduction meetings rather than a focused topic driving the coordination process specific to the construction in a separate forum.

Case Study: Runway Construction at Large Hub West Coast Airport

Air Traffic and flight operator representatives were engaged late in the planning process and met with resistance when suggesting changes to phasing and other project elements. When the Airport Construction Advisory Council and System Operations Services engaged, progress ensued and playbook development was initiated with all parties participating. Other large hub airports indicated that playbooks were not developed for similar projects, highlighting the lack of standardization of process for all aspects of construction planning.

Case Study: Runway Construction at Primary Diversion Airport on East Coast

During this rehabilitation project, NAVAIDs providing vertical guidance on published Instrument Approaches were taken out of service due to multiple reconfigurations of the primary runway. The primary operators at the airport attempted to engage the project sponsor early enough in the planning process to develop temporary Area Navigation (RNAV) procedures associated with the proposed construction phasing. Unfortunately, insufficient lead time and resources were available to publish the temporary procedures. Ultimately, the project phasing was adjusted to minimize operational and safety impacts on the operators, and a temporary Precision Approach Path Indicator (PAPI) was installed to provide visual vertical guidance to the relocated landing threshold. While an acceptable mitigation was reached, earlier engagement and a more collaborative process could have addressed the identified issues in a more proactive and effective way.

Case Study: Runway Construction at Large Hub East Coast Airport

The Airport Operator included all stakeholders early in the design process. Numerous stakeholder meetings were conducted during design and before the contract was advertised for bid. FAA Air Traffic, Tech Ops and Airports were partners with the airport engineering and operations staff. The airport also briefed many other airports and construction engineering firms at airport industry association conferences.

These case studies suggest some of following challenges in effectively planning complex construction:

- Having clear leadership on a project, either in a specific individual or a team comprised of multiple stakeholders, that has clearly defined responsibility, accountability and authority (RAA) for the project;
- Sustaining focused and consistent engagement by the project sponsor with FAA and industry stakeholders;
- Establishing early involvement in the design process to allow evaluation and development of safety or efficiency related mitigations, and, if necessary, modifications to design or construction phasing; and
- Ensuring all appropriate stakeholders from the flight operators and FAA are aware of, and included in the design process.

"Ideal" Complex Construction Timeline

The TOC reviewed the planning process for several major construction projects and proposed an "Idealized" timeline for complex construction projects. The following are the key elements of an idealized timeline:

- Engage the right group of stakeholders with the appropriate lead time during engineering design reviews and initiate modeling work if airport capacity will be adversely impacted;
- Allow for operator input into the design, and provide time for operators to provide feedback and adjust operating schedules, when necessary;
- Provide time for the FAA to develop temporary instrument approach procedures or other procedural mitigations as appropriate;
- Require pro-active leadership from the airport operator to engage the appropriate organizations to support complex construction, which is paramount for enacting such an idealized timeline.

In the depiction below, the initiation of planning for complex construction needs to begin about 2 years prior to the Notice to Proceed (NTP) (for construction) with involvement from the broader stakeholder community, including the airport sponsor, air traffic control, technical operations and flight operators. During the first 12 to 18 months of planning, the focus is on developing design options and iterating and modeling those options. Modeling may be done by either the airport operator or FAA or both for analyzing surface operations, developing alternative instrument flight procedures, determining hourly arrival and departure capacity rates, and quantifying potential delay scenarios. Modeling results may impact the phasing of the construction or establish the need to make unilateral or negotiated schedule changes to minimize the impacts to the traveling public. This effort involves all stakeholders, including airport consulting engineers, flight operators, ATC and Tech Ops. Throughout this design effort, the ADO and airport operator continue to coordinate on the phasing and other elements of the draft CSPP. As the project design approaches 90-100%, flight operators, Air Traffic and System Operations Services should have the requisite parameters to plan flight schedules, adjust aircraft fleeting, and develop operational playbooks and required SIRs. Additionally, the NPI teams should have the appropriate information to finish planning any required NAVAID relocations or alterations and reimbursable agreements.

Approximately 6 to 9 months before the NTP, that is start of construction, the process transitions from a design and development phase to one focused on execution: Air Traffic develops and tests alternative procedures and prepares to train controllers, temporary flight procedures are finalized and confirmed for timely publication, Technical Operations plans for shutdown of equipment and flight operators make final adjustments to schedules, aircraft, and crews.

While projects requiring IFP (Instrument Flight Procedure) modification or new publication are not by themselves necessarily complex, the airport needs to identify the procedure requirements early and begin advanced coordination on the IFP development two years in advance of when the procedures are needed, given current development timeframes and resource commitments. In the event less time is available, there are alternatives such as engaging the services of a third party procedure developer, or in some cases, an individual flight operator to expedite the availability of procedures.

Figure 9 Ideal Timeline for Complex Construction

Recommendations for Complex Construction Planning

Recommendation 8. Develop a process for classifying expected construction as "complex".

This process is intended to identify those projects with the highest operational impact in the NAS since it takes resources to align the many stakeholders involved in planning complex projects.

First, criteria are required for classifying a project as complex. While the TOC does not suggest definitive criteria, these could include (but are not limited to) some combination of the following parameters:

- Type of Airport
  - Core 30
  - Slot controlled or schedule facilitated airports (or with possible construction-induced delays that could necessitate such actions)
  - Part of a busy Metroplex (congested/complex airspace)
  - Single runway airport
  - Other pool of critical airports (namely diversion airports, busy spoke airports, tech stops, cargo hubs, any airport part of an ETOPS plan, related airport categories in Performance Based Navigation (PBN) Strategy document)
  - Key airports for business aviation
- Type of Construction

- Runway rehabilitation or reconstruction, construction involving displaced/relocated thresholds or shortened runways resulting in declared distances
- Taxiway to runway conversions
- New runway construction or runway decomissioning
- New or revised IFPs needed (but not a single factor)

Along with some of the criteria above, the FAA may consider leveraging criteria used in ARP's AIP Construction Plans and Specifications (P&S) review matrix as another mechanism to categorize projects. The P&S criteria use type of project, primary/Part 139 versus non-primary airport and cost of project to parse projects for the level of review required by ADO staff. Certain levels of review may be used as the basis for establishing complexity.

An evaluation or assessment process should be required to determine if a construction project meets the criteria to be designated as complex. It must occur early in the design process, preferrably at the initial pre-design meeting and before the initial draft CSPP is developed. The evaluation team should include the ATM, the airport, local flight operators and Tech Ops, at a minimum. Any stakeholder should have the option to bring a project to the table for consideration as this is ultimately a subjective assessment. This assessment may be best accomplished at existing periodic FAA/industry engagements such as National Customer Forum (NCF) or TOC Committee meetings. Periodic engagements of TOC Regional Task Groups, Deputy Directors of System Operations and NPI teams in the Service Areas may also serve as opportunities to make initial project assessments between industry and the FAA.

Recommendation 9. Plans for complex projects should be briefed to industry at least two years in advance of the NTP and on a well-defined schedule linked to project design.

The monthly NCF meeting is a logical venue for hosting such briefings using data from the construction clearinghouse. A minimum of two NCF meetings per year could include individual airport complex construction briefings, with more scheduled if volume warranted. The individual airport operators could be invited to present project overviews, or alternatively, the briefing could be lead by the local ATM or System Operations representative. The ACAC may be a valuable resource in organizing and scheduling these briefings to industry.

Recommendation 10. Identify and document key roles and RAAs for engagement of key stakeholders during planning and design.

There is a need to define RAAs for key stakeholders at the local level for project coordination. Key stakeholders may include the airport operator as the project sponsor, local Air Traffic for feedback, guidance and playbook development, System Operations for modeling, ACAC for overall process guidance, operators for engagement and input into design and modeling, etc. A key question is how such RAAs would be institutionalized to be effective for complex projects.

Additionally, RAAs are intended to define required roles for effective project planning and the roles may be assumed by different people in different airport projects. For example, in previous complex projects, the 'Ombudsman' role has been owned by leadership from System Operations in Headquarters as well as by the Manager of Tactical Operations (now known as the DDSO). The intent of this recommendation

is not to be prescriptive on exactly which individual should fill which role but instead to identify the critical roles and ensure a process exists to identify individuals to fill those roles.

Recommendation 11. Identify a leadership team for the effort to drive schedule, manage process, keep participants on task, etc.

At a minimum, a leadership team should include FAA participation (examples include, but are not limited to DDSO, Regional Administrator, local ATM, Service Center, etc.) and the airport operator. If the project sponsor is Tech Ops, this team should also include Tech Ops. For slot controlled or large hub airport projects, System Operations (represented by the DDSO) must also be part of the leadership team. Finally, the FAA may consider involving operators through a lead operator concept. The leadership team should be institutionalized in the RAAs.

This leadership team should review the FAA's Corporate Workplan early in its construction design process. The Corporate Workplan may include information on opportunities to synchronize airport construction with other NAS requirements that may reduce future operational disruptions. For example, in some airports Tech Ops has taken advantage of runway construction to replace underground cabling at the same time.

In addition to RAAs, the FAA and airport operator partners may also consider a documented Structured Teaming that formally establishes an agreement among participants. Such agreements have been used successfully in recent complex projects, including a current effort at LAX. The Structured Teaming between the FAA and Los Angeles World Airports (LAWA) is included in Appendix D to this document.

Recommendation 12. Develop an Airport Construction Action Plan (ACAP) template with checklists, timelines and associated requirements that facilitates coordination of any construction projects deemed "complex".

Currently there are multiple checklists available in support of airport construction. The Runway Template Action Plan (RTAP) is used during new runway construction, the ACAC has multiple checklists for different project types, System Operations has developed checklists and FAA Advisory Circulars include them as well. Existing checklists may be integrated to develop a master library of checklists. These can be applied to different construction projects as appropriate. In addition to checklists, the template should include approximate timelines that indicate which types of stakeholders should be involved at what times in the process. The ACAP would be applicable for any type of project but required for complex projects. The goal of an ACAP is to foster a collaborative environment with stakeholders and instill awareness of the processes so that even smaller airport operators can use them. Sample checklists are included in Appendix E of this report.

The TOC recognizes that there would be a need for identifying an organization within the FAA that owns and continuously improves a construction action template. The TOC suggests the FAA consider expanding the scope and staffing of the Airport Construction Advisory Council to own such a template.

Recommendation 13. Ensure complex project sponsors schedule monthly or bi-monthly stakeholder meetings.

Previous complex projects with successful outcomes have been characterized by a cadence of regularly scheduled planning meetings. Many large airports already have exising meeting formats and have utilized these forums for regular construction coordination meetings. Other airports that do not have an existing monthly or bi-monthly meeting may need to schedule a series of ad hoc meetings to effectively cooordinate complex construction projects. It is imperative that all members of a complex project team regularly participate in monthly or bi-monthly stakeholder meetings. The concept of stakeholder meetings is also included in the Advisory Circular "Quality Management for Federally Funded Airport Construction Projects." Finally, these meetings should start as early as 24 months in advance of construction in a kickoff predesign meeting where project scope is reviewed to ensure operators, the ATM and other stakeholders have time to provide input into the project phasing and consider impact mitigations. The frequency of meetings may even have to escalate based on the level of activity in the planning cycle.

Recommendation 14. There should be a mechanism for complex projects to report to FAA HQ Leadership (on an exception basis) if high level attention is required.

Historically, the RTAP, which has focused on new runway construction, has found that periodic high level Headquarters attention helps to keep the construction process moving effectively. Currently, the ACAC does provide updates to Air Traffic Services, Safety and System Operations Vice Presidents in the Air Traffic Organization. The FAA should consider expanding this reporting for "at risk" projects to bring necessary attention to avoidable consequences from a wider set of executives in the FAA, including ATO, Flight Standards, and Airports.

Recommendation 15. Ensure awareness of modeling efforts and sharing of assumptions among FAA, airports and flight operators.

Case Studies: Two Large West Coast Hub Projects

An Airport Operator conducted preliminary modeling of several phasing alternatives to quantify expected delays and costs of construction. Ultimate phasing was a compromise among those elements. The FAA did additional modeling to support scheduling discussions with the air carriers at the airport and mitigate expected delays. The timing was such that the air carriers were able to make needed schedule adjustments.

Another major airport embarked on a multi-year construction program and conducted none of its own modeling. It relied on the FAA to model various runway closures and identify delay levels and expected Airport Acceptance Rates (AARs) and Airport Departure Rates (ADRs). Additionally, although the FAA was brought late into the process, it was able to develop its model and results quickly. All of this occurred late enough in the design process that it did not support timely schedule adjustments by the air carriers.

Different types of modeling are needed by different organizations for different purposes. Modeling is of particular importance at the Core 30 airports. Each type of modeling has its own unique value and purpose, and there is no need for one model to govern them all. Examples of modeling include:

- Airport modeling to assess impacts of construction phasing alternatives;
- Air traffic modeling to estimate arrival and departure rates for use during construction in different configurations and weather conditions;
- For slot constrained airports (or those with possible slot implications), modeling impact to NAS of systemic delay and to assess mitigation with different schedule options between operators.

When different stakeholders conduct modeling for different purposes, there is risk of inconsistent or divergent results. There is a need to improve the consistency of modeling results among the different stakeholders to ensure all parties fully understand the impacts of the construction on airport capacity and delay and to accurately portray the costs and benefits of alternative phasing strategies. At a minimum, awareness of different modeling efforts by stakeholders is worthwhile to avoid duplication of effort and allow for comparison of input parameters that may affect the results. As different stakeholders conduct different types of modeling for different purposes, it is unlikely that coordination on modeling efforts would result in only one coordinated modeling effort. However, coordinating modeling efforts by sharing data, parameters and assumptions should serve to reduce the differences between the results. System Operations Services develops capability briefings in an effort to educate and tie the FAA and the airport operator more closely together. Smart sheets (output data) and briefings show the types of modeling and results: throughput rates, estimated taxi in and taxi out times, estimated airborne delay, anticipated surface movements and comparisons of alternative phasing plans developed to mitigate delays and improve efficiency during construction.

The sharing of assumptions and inputs as applicable can speed up and improve coordination between multiple modeling efforts. This should help to increase awareness and foster collaboration among the various stakeholders; and ultimately, improve the overall modeling process. Finally, whenever any modeling is pursued, a point of contact from Air Traffic should be immediately identified to provide input into the modeling.

Earlier recommendations suggest the need for RAA's to define the mix of roles and responsibilities in construction planning. RAAs should include reference to which parties are responsible for different types of modeling.

Recommendation 16. Proactively seek opportunities to integrate NextGen capabilities during construction.

The FAA and industry are pursuing a transition to a NextGen PBN NAS and airport construction clearly affords an opportunity to enable change. Recent extended runway closures at Atlanta and JFK provided an incentive for early implementation of Wake Recategorization (ReCat) at those terminals to reduce the delays associated with the loss of runway capacity. In both cases, significant delay reductions were realized minimizing the impacts to the air carriers and the traveling public. Special RNAV procedures were developed for EWR, SFO, LAX and JFK to increase efficiency, enhance safety, deconflict airspace, reduce delay, and provide an instrument approach with lower minimums for use during runway closures. All of the procedures developed were used effectively during the construction. Identifiying NextGen solutions during construction may aid in managing the operational impacts from the

construction event and also in furthering NextGen implementation itself by demonstrating measurable benefits.

Repeatable Construction Execution

Airport Construction and Instrument Flight Procedures

Instrument Flight Procedures are designed and developed using the Current Obstacle data base for procedures. There are currently over 17,000 Instrument Flight Procedures in the National Airspace System including Standard Instrument Departures (SIDs), Standard Terminal Arrivals (STARs), RNAV, Required Navigational Performance (RNP), legacy Instrument Approach Procedures (IAPs) and Obstacle Departure Procedures (ODPs). There are two kinds of effects to procedures caused by construction: 1) permanent changes that drive re-development or new development of procedures and 2) temporary restrictions that are captured by NOTAMs. Improper or untimely handling of NOTAMs for construction on or near airports has unnecessarily limited the use of critical instrument approach procedures and caused delays or diversions.

Data Issues

In order for the AIS Instrument Flight Procedures (IFP) Group to develop new or amended procedures that are either needed temporarily during the construction or once it is complete, there has to be considerable advanced planning. New or amended procedures may require up to 18 months for development and publication based on the Procedures Production Pipeline. Challenges in timely procedure development in the past have been driven by inaccurate or incomplete data needed for development. Airport and obstacle data is the foundation for procedure development. As data accuracy has greatly improved over time, however, the timing of data availability is critical to construction execution. This issue should be highlighted in any template or checklist associated with construction in the future. Note that in a later section of this document focused on recommendations related to improving safety during construction, data again emerges as a significant item.

As-Built Surveys

Recommendation 17. Synchronize collection and dissemination of Survey Data with the Instrument Procedures Production Cycle.

The safety of instrument flight procedures relies on accurate and timely data. One specific data issue that has been identified is differences between pre-construction surveys, which are often used to develop procedures, and as-built, or post construction surveys. If the difference exceeds certain threshold criteria, then it may be necessary to cancel the procedure, that is NOTAM it unusable until the procedure can be modified. Hence, there is a need for AIS to receive as-built surveys, including associated coordinates and elevations, on a timely basis from the airport operator. Unfortunately, this does not always occur as described in the case study below. This is not an isolated incident and occurs frequently in the NAS.

Case Study: Small GA Airport and 3rd Party Survey Data

A small GA airport extended a runway and raised its elevation. An initial survey was conducted in 2014. The FAA Flight Procedures Team received the initial survey data from the airport operator, but there

were concerns from the airport that the survey data was not correct. As a result, a Notice to Airmen (NOTAM) was issued indicating the new RNAV (GPS) procedure to the runway was Not Available (N/A). To reconcile the issue and potentially activate the procedure, a new, as-built, aeronautical survey is required, however the airport indicated a new survey will not be done until the summer of 2016, over a year after construction was completed. Given challenges in aligning data from multiple stakeholders, the IFP Team regularly "NOTAM" procedures "N/A" until the IFP, airport and construction processes are all aligned.

Another issue that causes problems is the fragmented manner in which the airport surveys are processed to Aeronautical Information Services. In many cases the Airport and Obstacle Survey data are split up and arrive in the database with no alignment to the production cycle. The disjointed process of gathering data and development of procedures drives additional workload and introduces delay. Aeronautical Information Services has made some progress in aligning these processes but additional effort is required. Ideally in the future, data should not be processed if it is not aligned with the procedure production cycle. The current approach to "N/A" procedures may be improved by acquiring the right data at the right time as input into the procedure development or evaluation process. Ultimately the option to "N/A" procedures due to evaluation against tolerances should be the exception instead of the standard, as it is currently.

The FAA should continue to support existing Working Groups that are identifying the details of how to synchronize the various processes associated with survey data and procedure publication.

Magnetic Variation

Recommendation 18. Prepare the Magnetic Variation Letter and send it to Aeronautical Information Services far in advance of planning any required marking or signage changes and coordinate airfield changes with instrument flight procedure revision cycle.

Issues continue to be encountered with uncoordinated Magnetic Variation changes affecting instrument flight procedures, and airport signing and marking. It is important for an airport to know in advance if the airport and NAVAIDs will be having a Magnetic Variation change based on the EPOCH Year of record. Flight Standards mandates updating Magnetic Variation when out of tolerance. If the Magnetic Variation is not properly planned it can result in a difference between published aeronautical data and visual aids on the airport, which requires re-painting and installing new airport signage. Other industry Working Groups, including the PBN Aviation Rulemaking Committee (PARC), have also identified shortfalls in current processes related to Magnetic Variation. The PARC report states: "It is recommended that a standard way of providing runway magnetic bearings be established that allows its application consistent with the procedure updates."[8]

Determining changes in Magnetic Variation is somewhat predictable and should be known years in advance. While information on Magnetic Variation is available earlier, the Magnetic Variation letter is prepared today just three months before procedures are published. The letter of notification to Airport

[8] "Magnetic Variation Review and Recommendations," Performance Based Navigation Aviation Rulemaking Committee, June 17, 2013

Operators needs to happen earlier in the process. If the letter can be accomplished as much as 1 to 2 years in advance, Magnetic Variation changes could be synchronized with the charting cycle, construction projects, and any required airfield changes.

Finally, Magnetic Variation changes can be tied to previous recommendations. It should be included as a checklist item in an Airport Construction Activity Plan template as well as be part of any Desk Reference for Airport Operators to understand their full set of requirements.

Process for Temporary Obstructions/Cranes for On-Airport Construction

Airport construction projects may require placement of numerous temporary obstacles in the vicinity of airport movement areas that may affect approach and departure surfaces, especially during periods of instrument meteorological conditions (IMC). Most of these obstructions are cranes. Lessons learned from a large hub airport in early 2015 (see case study below) show that insufficient control or management of temporary obstructions can have a major impact on operations during all weather conditions. Control of obstructions implies a documented system or effective plan to continuously monitor the status of temporary obstructions and to ensure timely removal (lowering) when necessary to mitigate the impacts to Instrument Flight Procedures. Effectively managing temporary obstructions is made more complex because only one NOTAM may be published for each IFP. When there are multiple Cranes in an area around the airport with constantly changing conditions, the process can be difficult to control.

Case Study: Impact of Crane on Arrivals at a Large Hub Airport

In early 2015, during construction at a large hub, temporary cranes on the airport surface necessitated Flight Data Center (FDC) NOTAMs restricting instrument approach procedures to two runways. The NOTAM for the CAT II/III IAP to XXX was as follows:

"FDC X/XXXX – XXX ILS RWY XXX (CAT II/III) Procedure N/A: Temporary Cranes up to 267 MSL beginning 936 feet northeast of RWY XX"

On one specific day, weather at the airport degraded such that operators could no longer operate the instrument approaches to two key runways according to these NOTAMs. At 0400 local time, the project contractor left a voice message to the airport and the FAA's local Airport District Office that the crane was down. The message was not submitted into the process for NOTAM cancellation, and the CAT II/III arrival remained NA with the FDC NOTAM still published even though the associated crane was down. The weather at the airport worsened such that CAT II/III minimums were required for aircraft to land at the airport. Arriving aircraft began to divert as the CAT II/III IAP was NA.

At 0545 local, the airport operator conducted a visual search to verify that the crane was still up. At 0715 local, the Air Traffic Control tower requested the NOTAM be cancelled, as the airport operator was unable to locate the crane. By that time, there were 32 diversions, many of which were wide body international aircraft. There were 611 total minutes of holding, average delays of 121 minutes due to ground stops and average delays of 74 minutes from ground delay programs.

Recommendation 19. Ensure there is a 24/7 NOTAM response to notification of changes in status for on-airport obstacles.

The way temporary obstructions are handled today depends on whether the obstruction is on or off airport property: on-airport obstacles are evaluated at the Flight Procedures Team at the Service Centers; off airport obstacles are evaluated by Aeronautical Information Services (AIS) and then forwarded to the Instrument Flight Procedures Group team, both of which are in Oklahoma City. These impacts are required to be at the IFP Team 72 hours prior to the obstruction being in place so that the IFP Team can evaluate the impact to procedures and issue a Temporary NOTAM. Currently, the FPTs, which handle on-airport obstacles, are available during standard business hours, Monday through Friday. For AIS to receive the same impact information for on airport obstacles outside of standard business hours that they do for off airport, either the FPTs would need to offer 24/7 service or the responsibility (contact point) could be moved to Aeronautical Information Services (AIS).

Recommendation 20. Require project proponent (owner of 7460 submission) to work with crane operators to notify the Tower, TRACON and/or Airport Operator when raising or lowering a crane.

The Obstruction Evaluation / Airport Airspace Analysis (OE/AAA) application is the tool used to coordinate information on obstacles, and is also used by proponents to cancel the Obstacle/Crane activity. During normal duty hours the process appears to work well but recent instances across the NAS, such as the case study about the impact of cranes on arrivals, have shown that cancellation of active NOTAMs can be challenging. Air Traffic Control has resorted to “work arounds” to mitigate the effect of NOTAMS. These include notes on the NOTAM saying “Unless Otherwise Authorized by ATC” or similar tactical solutions. These work arounds do not solve problems for operators in many cases because, during planning, operators are required to comply with the NOTAM as published. When notified by ATC that the obstruction is not in place, it is often too late for flight operators to adjust. Potential flight operator impacts from NOTAMs related to IFPs, such as reducing payload, are not easily reversible decisions. If the Obstruction/Crane operators do not lower the Crane and notify the FAA through the formal process, then the impact on the procedures will be in place until the situation is resolved.

As the crane case study demonstrates, simple verification of crane status can be challenging. Improvements to notification of crane status and contact information for crane operators should assist in improving this process as well.

Recommendation 21. The Instrument Flight Procedures Group should continue to maintain a tracking system that details all Temporary Restrictions to Navigation and their effects on Flight Procedures (Crane Tracker).

Since the events described in the case study above the Aeronautical Information Service Instrument Flight Procedures Group put together a plan to develop an application to better track temporary obstructions and to assist in quickly evaluating the effects and returning minimums whenever possible.

After hours, the 24/7 NOTAM office, whose primary duty is to issue NOTAMS in response to NAVAID outages, responds to NOTAM requests due to crane status that effect on-airport operations. Priority is given to the high impact 45 airports. This change in operations has helped to mitigate potential problems and additional operational advantages may be gained with some further modification of processes. Some of the recommendations here will be easy to implement, others will require a change in culture and possibly effect where certain functions are accomplished and by whom.

The Crane Tracker tool, developed following the case study from early 2015, assists in identifying the greatest impact on flight procedures based on the status of all cranes in an area. The tool documents NOTAM actions to be taken with special emphasis on the core 30 airports and additional 15 high impact airports. The IFP group developed and deployed this tool in response to the NOTAM problems in from the crane case study in early 2015, and it is showing progress. This tool will continue to be a critical component to ensuring effective management of the impacts of temporary obstructions, however no out-year funding is currently allocated to it. Funding should be allocated to sustain this capability.

Recommendation 22. The Contingency plan for all On-Airport temporary obstacles that impact instrument flight procedures should be developed and implemented for all major airport construction.

Although there are requirements for airport operators to have a plan for management of temporary obstacles case studies demonstrate that issues still arise in management of obstructions. Given the potential impacts of temporary obstacles on IFPs, a contingency plan should be in place for mitigating obstacle impacts during IMC. Note that a contingency plan for airport construction is much broader than just obstacles and IFP impacts. Whenever the weather goes below minimums, there are multiple contingency concerns that should be included in a general contingency plan. Such a plan should be included as part of an Airport Construction Action Plan template.

Additionally, both on and off airport obstacles impact IFPs and operations. This recommendation is focused on on-airport obstacles. This is not intended to reduce the importance of off-airport obstacles, but managing and mitigating impacts of off-airport obstacles is significantly more complex. This topic is addressed in the next section.

Active management of construction-related obstructions should include the responsible party (“Crane Sherriff”) to confirm cranes are down. Such a plan should be maintained for all airport construction involving a temporary obstacle and go into effect when the weather is forecasted to go below lowest minimums. When this occurs, cranes will typically not operate for construction purposes, and flight operations will be best served if cranes are lowered and unnecessary obstacles to flight procedures are removed.

Temporary Obstructions/Cranes for Off-Airport Construction

Recommendation 23. Establish a Working Group with key stakeholders (Airport Operators, FAA, airlines, jurisdictions, construction industry, etc.) to develop a robust process for managing the impacts of off-airport construction in a manner that does not overly restrict local growth while also maintaining flight safety and efficiency.

Similar to on-airport obstacles, off airport construction also poses a potential impact to Instrument Flight Procedures and airport operations. For off airport construction, however, the complexity of managing obstacle impacts to operations is significantly more complex than for on airport. The safety and efficiency impacts to flight operations are no different.

The importance of off airport obstructions was highlighted by recent events related to a construction crane near the final approach course for a runway at a key large hub airport in the NAS. This prompted the Task Group to discuss the impact of off airport obstructions and draft recommendations related to off airport construction, recognizing the topic was potentially outside the scope of this group. The primary recommendation is creation of a broad industry working group to address this topic. Key points raised during discussion of off airport construction included:

- Inconsistent knowledge of and compliance with FAA form-7460 requirements by off airport project sponsors.
- Clarification of legal authority for airspace decisions. As documented in AC 150/5300-13[9], airport operators have responsibility for airspace including impacts but do not have property rights beyond airport limits.
- Consideration of outreach and education for contractor or crane operator industry associations on FAA form-7460 requirements.
- Consideration of whether there are opportunities to influence OSHA guidance to crane operators to better inform such operators of their aviation-related requirements.
- Investigation of whether enforcement action is feasible or required for operators that are out of compliance with their 7460 requirements, especially in cases that pose a significant risk to flight operations.
- Operator concerns regarding the safety and efficacy of mitigations proposed to accommodate off airport obstructions in close proximity to arrival and departure flight paths.
- Consideration of whether FAR Part 121 (and others) operator one engine inoperative (OEI) takeoff performance should be considered as part of the Obstacle Evaluation/Airport Airspace Analysis (OE/AAA) process. These OEI surfaces are currently not considered in the impact assessment of proposed structures, and there is a gap between what FAA requires of operators (FARs) and what adverse impacts are included in obstruction evaluation.
- Explore establishment of local or regional airport working groups comprised of flight operators, airport operators, FAA, and local political jurisdictions to aid in review of proposed off airport construction projects, potential impacts, and appropriate mitigations.

Level of Detail in Information on Obstacles

Recommendation 24. Include the OE/AAA number and Latitude and Longitude of Obstacles impacting flight procedures.

[9] See: paragraph 104, Airport operator responsibilities, Section b. Maintenance of obstacles clearance surfaces on page 26 in AC 5300-13A, change1.

Currently the latitude and longitude of temporary obstacles are included in most NOTAMs worldwide but are not included in US NOTAMs. When flight operators do not have the precise details for an obstacle, they must make conservative assumptions about the obstacle location and possibly the height that may drive unnecessarily large impacts on takeoff performance (takeoff weight) due to the requirement to consider one engine inoperative performance for obstacle clearance. In an effort to minimize adverse impacts on takeoff weights and to harmonize with the procedures used outside the U.S., it is recommended that latitude and longitude information be integrated into FDC NOTAMs. This would not replace any information currently published in obstacle NOTAMs. Also, this recommendation is consistent with a recommendation made by Operational Working Groups of the International Air Transport Association.[10]

Recommendation 25. Provide flight operators with draft information on temporary and permanent obstruction impacts to IFR flight procedures earlier than the current 72 hour prior timeframe whenever possible.

Current procedures specify that procedure changes caused by temporary obstacles are published by NOTAM about 72 hours prior to the obstacle being in place. For flight operators, having impact information sooner would assist in making tactical adjustments in response to these NOTAMs, such as fleet swaps if, for example, GPS is required due to equipment outages. A flight operator needing to make a fleet swap would benefit from having this information prior to the 72 hour in advance publication timeline.

The Crane Tracker may have promise as a mechanism to share such information between FAA and industry outside of the NOTAM publication cycle. The FAA is using the Crane Tracker to evaluate obstacle impacts and draft NOTAMs within that system. It is worth exploring whether enabling access to draft impacts within the Crane Tracker data base may address this request. Also, by providing such information earlier to flight operators, it may enable a dialogue between operator and the FAA on the impacts that may have been missed or not fully identified when the obstacle was circulated for comment.

Additional Recommendations Associated with Construction Execution

Information Sharing During Construction

Recommendation 26. Develop repeatable approach to share construction status information throughout execution, especially for complex projects.

Information on construction project status is important for operational stakeholders, especially for complex projects with multiple phases and changing impacts. Operators need to understand current status and projections of what airport resources will be available and when, before NOTAMs are issued. Currently there is no standardized format for providing runway declared distances, NAVAID availability

[10] "Educational Paper on Obstacle Clearance and Engine-Out Analysis, A Summary for NOTAM Releasing Authorities," Airplane Performance Task Force (APTF), International Air Transport Association (IATA).

and other operational data to stakeholders before and during construction. During recent multi-phase runway closures at JFK, operational data were disseminated to the airport community via a "Runway Availability Matrix," that was updated and distributed a weekly basis. An example of this is included below:

Figure 10 Sample Runway Availability Matrix from Construction at JFK (partial list of runways)

Stage	Start Date End Date	Runway Available Length									
		4L		22R		13R		31L		13L	
		TAKE-OFF	LANDING	TAKE-OFF	LANDING	TAKE-OFF	LANDING	TAKE-OFF	LANDING	TAKE-OFF	LANDING
Pre-Construction/ Existing	January 1, 2014 August 8, 2014	11,351	11,351	11,351	8,655	14,511	12,468	14,511	11,248	Existing	Existing
Stage 1 Completed	December 10, 2014 March 14, 2015	9,780	9,780	10,130	8,655	14,511	12,468	14,511	11,248	Existing	Existing
Stage 2	March 15, 2015 April 23, 2015	9,180	9,180	9,187	8,655	14,511	12,468	14,511	11,248	CLOSED	CLOSED
Stage 3	April 24, 2015 September 21, 2015	CLOSED				10,974	8,931	10,925	11,248	Existing	Existing
Stage 3 Completed	September 22, 2015 December 9, 2015	11,351	11,169	11,219	7,795	14,511	12,468	14,511	11,248	Existing	Existing
Final	December 10, 2015	11,351	11,169	11,219	7,795	14,511	12,468	14,511	11,248	Existing	Existing

Any information template should be included as part of the construction action plan template described in Recommendation 12 above. In the JFK example noted above, the information was maintained and provided by the Airport Operator via email distribution lists as well as through posting on its website. The information was updated weekly and included clear highlighting of what had changed relative to the previous week. Additionally, different reports provided declared distances, runway closures and taxiway impacts. Operational stakeholders have described this model of information sharing as timely, not onerous, highly comprehensive, and functional.

Updating Construction Status

Recommendation 27. Update airport construction diagrams using Federal NOTAM System (FNS) to ensure depictions are real-time, current and accurate.

Construction notice diagrams are already a valuable source of information for flight operators. If these diagrams are enhanced with real time information from NOTAMs, such as obstacle location, operators believe the value of these diagrams would be enhanced. This may be accomplished using the Federal NOTAM System to update the diagrams in real time. Current graphics are updated daily but can have stale information. Initially, graphics should be updated with airport movement area information (declared distance, etc) NOTAMs, but temporary on-airport obstructions should also be considered.

Given the increased utilization of Electronic Flight Bags (EFBs) and digital delivery of aeronautical information to the cockpit, there is strong potential to use those media to provide real-time construction NOTAMs and updated construction diagrams; and ultimately enable integration directly into airport moving map displays.

Electronic Reporting of Crane Locations

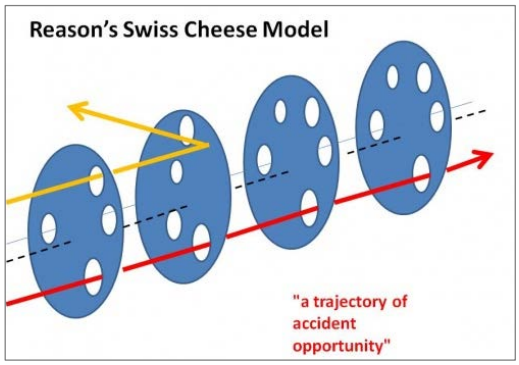
Recommendation 28. Explore software, OE/AAA system automation enhancements or GPS technology to report the height, latitude, and longitude of cranes in real time.

Cranes on or in the vicinity of an airport are obstacles that may impact flight procedures, aircraft performance, operational reliability and safety of flight. Understanding whether cranes are up or down can be challenging, particularly for those that are mobile and move throughout the day or have multiple vertical positions. The group would suggest consideration of installing technology on cranes, similar to that applied today for ground equipment at a number of airports, to provide real time information on crane status (location and height). This recommendation is intended to provide situational awareness only and not to replace official NOTAM data sources.

Safety-Focused Recommendations for Airport Construction

Aviation accident causation has been modeled by James Reason as "a series of slices of randomly-holed Swiss Cheese."[11] The holes represent individual weaknesses or risks in a component of the system. Historical analysis of aviation accidents has demonstrated that there is no one causal factor; instead, accidents materialize in the rare cases in which multiple individual risks occur at the same time. In the Swiss cheese model, this is represented in the cases in which a line can pass through a series of slices. This is depicted by the red line in the diagram below. The yellow line demonstrates that while in individual operations certain operational risks may materialize, in nearly 100% of operations the trajectory of a potential accident is averted.

Figure 11 Reason's Swiss Cheese Model[12]



Airport construction impacts operational safety both through temporary and permanent changes in airport infrastructure and operational procedures. Airport construction contributes a layer of Swiss cheese into the model depicted above. These changes may introduce new risk into airport operations that must be mitigated through the safety management process. Operational change is of particular concern for the operators that regularly operate into a specific airport for which construction has changed the operating environment, either through runway closures, shortened runways, alternative

[11] See: http://www.skybrary.aero/index.php/James_Reason_HF_Model
[12] See: http://www.skybrary.aero/index.php/File:Swiss_Cheese_Model.jpg

taxi procedures, unavailable instrument procedures, NAVAID outages, etc. Information synchronization and dissemination is of particular significance to enhancing safety during construction. Note that the issue of timely and accurate information dissemination was mentioned above in the section on Construction Execution.

The Airport Construction Advisory Council, which the FAA established in the last decade, has made tremendous progress in systematically managing risk that airport construction contributes to the NAS. The ACAC industry focus has been on staying ahead of safety concerns by proactively identifying risk mitigations that resolve issues before they impact operations. Improving safety requires collaboration, communication and clarity among a diverse set of stakeholders. The issue is not unique to air traffic controllers, flight operators and their pilots or Airport Operators. It is a joint endeavor involving all of these stakeholders.

While progress has been made, there is more work to be done and the following recommendations are offered to further enhance safety during construction:

Recommendation 29. Utilize ATC simulation capabilities to evaluate procedures and to prepare and train controllers for construction playbook.

To ensure consistency during construction across an entire staff of controllers, simulation is helpful to identify and refine a consistent way of managing changes during construction. Facilities should utilize available simulation tools and capabilities[13] to train controllers on new procedures, which should be catalogued in a playbook for dealing with each construction project. Simulation does take time and resources from multiple stakeholders, so facilities should consider a range of simulation options and utilize the appropriate tool based on the complexity of the project.

Collaboration on construction simulations between Air Traffic facilities and pilots or other airport operational stakeholders would enhance the safety benefit. All parties who operate in or control the movement area will have different perspectives to offer on a particular construction project. Additionally, participation among various stakeholders encourages buy-in and a shared sense of ownership of the construction project.

Finally, when possible, such simulations should be conducted early in the design process, to inform and refine the project phasing. The section on Complex Construction above discussed a number of other potential modeling efforts to be included in planning construction. Air traffic controller training could be another tool in this modeling and simulation portfolio. The earlier simulation can be accomplished during design, the higher its value in guiding phasing decisions, reducing risk, and preparing air traffic and flight operators to use alternative procedures.

[13] These may include a range of technical capabilities from table-top exercises all the way through interactive air traffic simulation systems

Recommendation 30. Allow the update of the Airport/Facility Directory (A/FD)[14] and Instrument Flight Procedures during the 28 day Change Notice (CN) process.

Occasionally, construction (paving) of new runways, taxiways, or ramps is completed before it is charted, marked, signed or lighted. It may be possible to open the pavement, but during this time, there is potential for pilot and controller confusion as available documentation may differ from the actual airfield configuration. For example, if a new taxiway is completed, but not open and is closed via NOTAM, and not properly barricaded, pilots may get confused at night or in low visibility conditions. Conversely, if charts are revised prematurely, before the pavement is officially open, similar confusion may occur.

As noted earlier in the discussion on Instrument Flight Procedures, a number of elements must line up for construction to be complete and infrastructure to be available to the operation – completion of the construction itself, updates to navigational databases, updates to charts, etc. If any one of these is out of alignment, the resource may be considered unavailable or uncharted for the operation and confusion may ensue.

Currently the A/FD publishes every 56 days. Instrument Flight Procedures are published every 56 days in the Terminal Procedures Publication (TPP), but can have changes included during the Change Notice (CN) at the midpoint of the cycle, that is, 28 days after the TPP. It is recommend that the policy be changed to allow A/FD and IFP changes during the CN process thereby cutting the time in half between updates.

Recommendation 31. When there is a gap between completion of construction of a facility and its availability to the operation, provide clear information about what resources are unavailable, and ensure areas are properly demarcated

As noted earlier, information on new, uncharted resources may create confusion. NOTAMs should include descriptive information about what resource is closed (i.e., Taxiway Juliet, which is North of Echo and South of Foxtrot, is closed). Additionally, low profile barricades should be used to physically block any resource unavailable to the operation.

Recommendation 32. Continue to communicate risk management culture to air traffic controllers, dispatchers and pilots, even during construction projects with seemingly minimal impact.

The FAA and Industry should continue to support a safety culture in air traffic facilities and operator communities that emphasizes caution during construction even if the construction is apparently limited in scope. Controllers see the airport operating environment throughout their shift and quickly adjust to the new conditions during construction. Pilots, however, may not operate into the airport frequently and even for those that do, any given flight may be the first time the pilot is interacting with new

[14] The A/FD is going to be renamed Chart Supplement in Spring 2016

operational conditions from construction. All operational personnel need to recognize that any flight could be the least familiar user of the airport at any point through the construction process.

Recommendation 33. Prioritize and promote visualization of construction impacts and mitigations to the pilot community.

Accurate and timely visualizations to the pilot on the flight deck can help mitigate risk during construction. Pilots may have expectation bias if they are flying into an airport regularly, and visualization of what has changed can be helpful to adjust expectations and increase situational awareness.

Visualization of construction can include multiple forms:

- Improving awareness among pilots of the availability of construction notice diagrams
- Provide pilots with charts or other renderings showing the location of cranes or other temporary obstructions. For current construction at a large hub with a key off-airport crane, the most effective method for one operator was to show pilots a Google Earth image with overlay of the location of where the crane is. Proactive visualizations to pilots aid in ensuring pilots are aware of such scenarios.
- EFB integration of D-NOTAMs and charts to identify closed or changed areas on the airport field.
- Integration of cranes and other obstacles on construction notice diagrams to provide a more complete picture to the pilot.
- Layer multiple components of information on one page and offer the option to the pilot to declutter by removing some layers from the display

Recommendation 34. Make fast track slots available in the charting cycle to respond to safety needs.

Airport construction in general, and runways and taxiways in particular, may prompt the need for expeditious changes to aeronautical data and charting. Often construction duration will be impacted by weather or other factors beyond the control of the airport or contractor, or by acceleration clauses in the contract. Alternatively, if temporary procedures are desired to improve safety or restore lost capacity, expedited access to the charting cycle will minimize risk from non-standard airfield configurations or the unavailability of instrument procedures.

The process for developing new or temporary instrument flight procedures takes approximately 18 months in the NAS today. Some construction projects impact existing flight procedures and may, for example, temporarily disable all procedures with vertical guidance during construction. In these scenarios, flight safety would be enhanced by temporary procedures that include vertical guidance. However, if a construction project did not initiate the IFP process early enough, having such procedures available during construction would not be an option. These changes may not always become evident until late in the design process or may be related to projects that were required on a rapid timeline. In either case, timely charting can be a challenge.

Having a portion of IFP production slots dedicated to responding to safety-critical needs for temporary procedures during construction would enhance system safety. There would be challenges to holding such "fast track" slots in reserve and ensuring they were solely dedicated to enhancing system safety.

Recommendation 35. Identify and solicit participation of a mix of subject matter experts for construction Safety Risk Management Panels that represent all key stakeholders in airport operations, air traffic operations and safety.

Currently there is only general guidance on what stakeholders or skillsets are required in a Safety Risk Management (SRM) assessment. As a result, participants in SRM panels vary across the NAS, with some including a broad cross section of stakeholders with high levels of operational knowledge and others lacking appropriate representation. Other panels have less representation or may be over-represented by one stakeholder group. There is a need to identify the cross-section of representative stakeholders for an SRM panel and provide this guidance. Such information could be included in an airport construction template.

Airport operators are particularly important participants in the SRM panel. As noted in AC 150/5370-2F, Operational Safety on Airports During Construction, the airport operator has responsibility to coordinate with the appropriate FAA Airports Regional or District Office early in the development of the CSPP to determine the need for SRM documentation. If the FAA requires SRM documentation, the Airport Operator provides documents necessary to conduct the SRM, participates in the SRM process, provides a representative to the SRM panel and ensures all applicable SRM identified risk elements are recorded and mitigated within the CSPP.

Recommendation 36. Consider improvements to SRM process to make it more effective.

The current SRM process is often scheduled as an in-person, review meeting and as a one-time event. Subject Matter Experts participating in SRM panels are often resource constrained individuals who are involved in many industry meetings and activities. To make SRM panels more effective, offering remote access and participation would improve the process. Additionally, if the process were scheduled as iterative sessions that developed a cohesive safety-focused team over time, it would further enhance the results of the panel's work.

Recommendations for FAA Tools, Process and Guidance in Airport Construction

The following offers a summary of high level recommendations for the FAA as they relate to airport construction:

Single Entity for NAS-Level Coordination of Construction

Airport construction is often described today as diffuse with no central information or authority source, though the ACAC has made strides as an emerging central authority.

The industry needs a NAS level single entity that owns the following activities:

- The Construction Clearinghouse to drive awarness of planned construction
- Drive the NAS assessment of which future projects are complex and require special attention
- Establish structured teaming arrangements between project owners,the FAA and flight operators for particularly complex projects
- Manage and improve upon templates for planning and managing construction
- Interface with local teams leading construction projects to provide guidance on enhancing safety and efficiency during construction
- Ongoing evaluation of stakeholder requirements to mature and evolve construction processes in the future. This may include evolving the clearinghouse into a future construction portal that includes all relevant data around the planning and execution of airport construction.

As noted above, the ACAC has already made progress on some of the above and is believed to be the logical entity to take ownership of NAS level purview of airport construction. Whether the ACAC takes on these duties or not, there are a number of questions the FAA will have to address:

- Any organization that acts as the central point of contact for airport construction should have an appropriate set of dedicated resources.
- This organization should not necessarily be a Headquarters Program Office. The intent could be met with field staff that are assigned with appropriate responsibilities and liaison flexibility. For example, the ACAC has been structured as a field driven organization with Air Traffic Managers working on a peer level with other ATMs. This model has worked for the ACAC and the FAA should evaluate this previous experience to help inform the right working model for the future.
- Management of the construction clearinghouse will require technical and database management skills that may require involvement of other organizations within the FAA that manage the tool.
- Effective ways to further involve and integrate non-FAA opertional personnel into the FAA's central process of tracking and managing airport construction. In particular this is relevant for airport operators, airport trade associations (ACI-NA, AAAE) as well as the FAA's own Airports organization.

Local Leadership Teams for Complex Construction

Airport construction will benefit from increased cross-functional project leadership. Across all construction projects there are as many as four key parties that could serve as critical parties in planning construction: the project sponsor (generally the airport operator), the FAA's Air Traffic Manager, the FAA's Manager of Technical Operations and Flight Operator(s) that operate at the airport. The recommendations in this report suggest the FAA seek mechanisms to build local teams that collaborate to bring the key stakeholder perspectives to construction planning and management and will serve to enhance construction coordination in the future. Structured teaming is one tool the FAA may wish to utilize to accomplish this goal.

Processes for Managing Obstacles

As discussed in the Recommendation 19, there are two processes today for tracking and managing obstacle status. One process relates to obstalces on an airport surface and the other relates to obstalces

that are off airport. The recommendations in this report call for aligning these two processes for managing obstacles. This recommendation is an indicator of the level of stakeholder interest in obstacles, both on and off airport.

Synchronization of Aeronautical Information

Multiple recommendations in this report discuss information as the foundation of operations and that information is necessarily changed during and after airport construction. Any confusion or lack of synchronization of information can increase risk as well as introduce inefficiency and operational disruptions. There is an overarching need to improve upon the flow of information and ensure that the underlying data is synchronized and apporpriately communicated to operators during and at the completion of construction.

Appendix A: Tasking Letter

U.S. Department
of Transportation
**Federal Aviation
Administration**

Mission Support Services
800 Independence Avenue, SW.
Washington, DC 20591

NOV 21 2014

Ms. Margaret Jenny
President
RTCA, Inc.
1150 15th Street NW
Washington, DC 20036

Dear Ms. Jenny:

Construction projects of various sizes are going on all the time in the National Airspace System (NAS). Construction activities can range from major, long-term projects such adding or improving runways or taxiways to relatively minor, short-term projects such as EMAS maintenance projects. Efficiency is usually most obviously impacted as Air Traffic adjusts arrival and departure rates to accommodate reduced available capacity or taxi in/out times increase. A more subtle impact involves introducing short term safety risk when a project takes a procedure with vertical guidance out of service for a period of time or increases pilot and/or controller workload complexity.

The FAA Office of Airports, Flight Standards, Regional Administrators, and the Air Traffic Organization work together with local airport authorities and aviation stakeholders at the Service Area, regional, and local levels during airport construction. While some impacts may be unavoidable, we can minimize unnecessary disruption and safety risk if risk identification and risk mitigation through planning, design and early collaboration and coordination are done effectively. The key to minimizing the impact of airport construction activities is ensuring the following:

- The right stakeholders are involved.
- Stakeholders understand risks and mitigations.
- There is a clear understanding among stakeholders of project roles and responsibilities to maintain safe airport operations during construction.
- There is a sharing and use of best practices and lessons learned.
- There is a transparent process to coordinate, track approvals, and implementation details.

There are many examples of projects where implementation went very well. However, there are other examples where coordination and collaboration could have been improved. Airports and the FAA organizations take different approaches to manage and mitigate construction safety risks and efficiency impacts. Best practices and lessons learned for each project may not be well understood or shared across projects or with stakeholders. The roles of the various FAA entities involved may differ or may not be clear enough to all stakeholders. Local airport authorities may not engage to the extent needed or early enough in the process. Aircraft operators may also not be included early enough in the process. Finally, we may not effectively engage the surrounding community to explain temporary shifts in aircraft noise or frequency. Incomplete or untimely coordination or involvement by key stakeholders may preclude the identification and implementation of effective mitigations to reduce safety risk and efficiency impacts.

To help the FAA address the issues noted above, we request the TOC to provide recommendations in several key areas related to airport construction coordination and implementation. They include:

1. Review select past airport construction projects and associated data and identify lessons learned and recommend best practices for future projects. This would include the review of available safety and efficiency data where construction issues were noted as a factor. Please recommend a mechanism to ensure we capture and share lessons learned from future projects.
2. Identify and evaluate current strategic planning initiatives/tools used by FAA stakeholders at the Headquarter, Service Area/Region, and Service Delivery Point levels and provide recommendations on a best approach.
3. Assess the use of agency orders, advisory circulars, and internal processes currently being used to guide airport sponsors in their management of airport operations during construction and provide recommendations on a best approach.
4. Identity all stakeholders internal and external to the FAA needed and define their roles in the coordination and implementation processes.
5. Describe needed outreach strategies associated with each stakeholder and include a recommended timeline for outreach for major, long term projects.
6. Identify a set of recommendations on how safety risk should be better managed for aircraft operations impacted by airport construction projects.

We believe the above work will lead to improvements in the coordination and implementation of airport construction projects and will lead to an increased ability to mitigate impacts to efficiency and safety. Such work will benefit the full range of aviation stakeholders. We will provide the subject matter expertise, including a representation from the Airport Construction Advisory Council (ACAC), available as needed.

We look forward to the results of this important work. We will work with TOC Leadership to provide a list of past airport construction projects as discussed in Sub-Task #1 above to help the task group identify projects to review. We will also provide safety and efficiency data as requested as well as orders and other documentation. Subject Matter Experts from various FAA lines of business will be available.

The FAA requests this tasking be completed by the 2nd Quarter, FY2016 TOC meeting. Once the task group is established, we will work with TOC Leadership to determine the schedule for interim reporting deliverables and milestones.

Sincerely,

Elizabeth L. Ray
Vice President, Mission Support Services
Air Traffic Organization

Appendix B: Members of the TOC Airport Construction Task Group

Steve Jangelis, Air Line Pilots Association
Frank Oley, Airlines for America
Chris Oswald, Airports Council International (ACI North America) (Co-Chair)
Eric Silverman, American Airlines, Inc.
Justin Towles, American Association of Airport Executives
Mark Hopkins, Delta Air Lines, Inc. (Co-Chair)
Jim Marcoux, Delta Air Lines, Inc.
John Dermody, Federal Aviation Administration
Kent Duffy, Federal Aviation Administration
Pedro Franceschi, Federal Aviation Administration
Freddie James, Federal Aviation Administration
Jeffrey Jones, Federal Aviation Administration
Khalil Kodsi, Federal Aviation Administration
Andrew Lamb, Federal Aviation Administration
Vered Lovett, Federal Aviation Administration
Jennifer Morris, Federal Aviation Administration
Pat Mulqueen, Federal Aviation Administration
Susan Pfingstler, Federal Aviation Administration
Terry L Rhea, Federal Aviation Administration
Dave Siewert, Federal Aviation Administration
Tony Tisdall, Federal Aviation Administration
Beverly Tulip, Federal Aviation Administration
Lynn Williams, Federal Aviation Administration
Greg Yamamoto, Federal Aviation Administration
Bill Murphy, International Air Transport Association
Lee Brown, Landrum and Brown
Celia Fremberg, Landrum and Brown
Paul Shank, Maryland Aviation Administration
Vincent Cardillo, Massachusetts Port Authority
Ric Loewen, National Air Traffic Controllers Association
Ralph Tamburro, Port Authority of New York & New Jersey
Trin Mitra, RTCA, Inc.
Bob Flynn, The MITRE Corporation
Glenn Morse, United Airlines, Inc.

Appendix C: Glossary of Terms Associated with Airport Grouping

Airport Grouping	Criteria
Core 30 Airports	1% or more of total U.S. enplanements (DOT's "Large Hub") or 0.75% or more of total U.S. non-military itinerant operations. Includes 30 airports – 29 Large Hubs and 1 Medium Hub. (Note: OEP originally had 35 airports. The five airports removed from OEP are CLE, CVG, PDX, PIT and STL)
Secondary Focus Airports (54 total)	Between 0.25% and 0.99% of total U.S. enplanements, between 0.50% and 0.74% of U.S. non-military itinerant operations, or in one of the 7 flight plan metro areas and having an ATC tower and either scheduled passenger service, at least 100 based aircraft, or at least one runway > 5000 ft. Includes 36 medium hubs, 4 small hubs, 2 non-hubs and 12 reliever airports.
Focus Airports	The entire list of both Core and Secondary Focus Airports, as defined above
Enplanement	A single revenue-generating passenger departing from an airport
Large Hub	An airport that handles 1% or more of the country's annual enplanements
Medium Hub	An airport that handles between 0.25% and 1% of the country's annual enplanements
Small Hub	An airport that handles between 0.05% and 0.25% of the country's annual enplanements
Non-Hub Primary	An airport that handles over 10,000 passengers but less than 0.05% of the country's annual enplanements
Reliever Airport	Large general-aviation airports located in a metropolitan area that serve to offload small aircraft traffic from hub airports in the region
Metro Area	A population center consisting of a large metropolis and its adjacent zone of influence, or of multiple closely adjoining neighboring central cities and their zone of influence. In this case, the metro area is an area with at least one Major Hub airport with surrounding airports that may have a direct effect on air traffic
Itinerant Operations	Operations performed by an aircraft, either IFR, VFR, or SVFR, that lands at an airport after arriving from outside the airport area, or departs an airport and leaves the airport area
ASPM 77 Airports	Developed by ATO Chief Operating Officer in an effort to include smaller but significant airports near other major airport groups. For example, Islip (ISP) and Teterboro (TEB) were included in the ASPM 77 to represent the New York area

Source: "Defining a New Set of 'FAA Focus Airports'", By AJG-6, Jim Littleton and Frank Soloninka, May 26, 2010

Appendix D: Structured Teaming Agreement Example

Federal Aviation Administration & Los Angeles World Airports
Los Angeles International Airport Construction Projects
Communications Plan

BACKGROUND: The Federal Aviation Administration (FAA) Western-Pacific Regional Administrator and Los Angeles World Airports Executive Director agree, to a strong communications process to provide both organizations with proper and timely coordination on all airside projects and runway safety work at Los Angeles International Airport (LAX). LAX continues to undergo major construction upgrades that will impact all runways at some point and will have a runway closed or shortened a majority of time through 2019.

PURPOSE: This plan documents the ongoing commitment between the two agencies to maintain an active and open dialogue. It ensures timely communications during the planning and execution stages of airfield construction at LAX and it provides project planners with a resource and venue to brief issues up to executives through their senior managers. This plan encourages frequent and routine communications among the existing levels and provides for a structured and organized process of open communications.

PARTICIPANTS: There are three levels of this structured communications plan; they are the executive level, the senior manager's level and the project planning level. Representation at the executive and senior manager level meetings must include the primary or alternate listed in the contacts section. Any substitutions to this must be coordinated in advance with each level respectively. See Attachment A for contacts of record. Project planning levels are not affected by this communication protocol.

MEETINGS FREQUENCY & LOCATION: The executive level will meet quarterly. The senior managers will meet monthly and when determined by them, will switch to every other month. Meetings for these two levels will be held on site at LAX airport conference rooms, upon availability, however may be moved with prior notice and may last 1 ½ hours. The next meeting will be scheduled at the conclusion of each meeting. Project planning level meeting's focus and schedules are not changed and participants are encouraged to continue attending routine meetings and conducting business as usual.

BRIEFING & COMMUNICATION NORMS: Discussion and briefings on other relevant aviation programs may be introduced in this forum. Senior managers will maintain frequent communications with immediate executive level and subordinate project planning leads within their organization and if necessary, will brief on current activities at the appropriate meetings. Subject matter experts may be invited on an ad hoc basis and a telecon bridge will be set up for the briefing or discussion. Nothing about this plan is intended to impede other communication channels.

Glen A. Martin
Regional Administrator
Federal Aviation Administration
Date: Oct. 07 2015

Deborah Flint
Executive Director
Los Angeles World Airports
Date: Aug. 27, 2015

Appendix E: Sample Checklists

Sample checklist on taxiway re-labeling from ACAC

Taxiway Re-labeling Checklist

Taxiway Re-labeling (re-marking) **Start date:**

		Required	Status	Date Complete	Reason Not Accomplished
	As Early as Possible:				
1	Review best practices/lessons learned	X			
2	Coordinate re-labeling coincidental to publication/charting date with sponsor Published Airfield Diagram depictions take 4-6 months; re-labeling prior to coincidental publications will require issuing NOTAMs Avoid re-using taxiway labels if the taxiway geometry changed on this (current) project; (adds complexity and may lead to confusion)	Best Practice			
3	Conduct and complete SMS activities (SRMD, SRMDM, etc.)	X			
4	Request Tower Simulator System (TSS) video database changes; ACAC helps set priorities	Best Practice			
5	Develop training materials; update the simulator/lab (if available)	X			
6	Advise/coordinate project with regional Runway Safety Office - accomplish local-regional RSAT focused on construction impact	X			
7	Tailor communication strategy to this project	X			
8	Review necessary LOA changes related to local organizations	X			
a	Airport authority	Best Practice			
b	ARFF	Best Practice			
9	Determine extent of surface surveillance (ASDE-X and/or AMASS) map changes needed and coordinate as necessary Allow sufficient time for Program Office (MMAC) response	X			
10	Coordinate and draft amended Movement Area LOA as necessary	X			
11	Review runway/taxiway marking/signage changes with airport authority - get Runway Safety involved	X			
12	Ensure runway/taxiway lighting panel is modified to include sections of lights	X			
13	Initiate request with AJV to amend airport diagram (NFDC)	X			
14	Create, approve, and publish changes to local procedures (SOP)	X			
15	Notify carriers/operators of changes in taxi routes	X			
16	Conduct initial briefing to operational personnel to raise their situational awareness	X			

Taxiway Re-labeling Checklist

		Required	Status	Date Complete	Reason Not Accomplished
	Within 30 Days of Re-labeling				
17	Confirm airport diagram change publication New diagram changes can require more than 60-days if survey information is not available; communicate to AJV office early to avoid charting issues - Jeppesen (especially); Garmin, LIDO, Maptech, too AIM (Christopher Criswell – FAA lead) will confirm - **do not** call chart/map vendors directly	X			
18	Conduct facility controller awareness campaign Posters, FLM crew briefings, etc. initiated NLT 2 weeks before re-labeling	X			
19	Conduct pilot awareness campaign; (i.e., INFO message, FAAST message) Letter to Airmen developed and posted	X			
20	Complete training (simulator/lab, if available) with graphics showing phasing	X			
21	Brief controllers/operational personnel (first briefing)	X			
	Within 2 Weeks of Re-labeling				
22	Brief FLMs/OMs/CICs on ATIS review requirements refresher prior to re-labeling	X			
	On Day of Re-labeling				
23	Re-brief controllers/operational personnel	X			
24	Stage project knowledgeable staff personnel in operating quarters on day of re-labeling (day and night shifts) Plans & Procedures personnel or facility project focal as applicable	X			
25	ATIS software checked to ensure information is broadcast digitally through ARINC This item is required only if facility has users that employ ACARS as a means of obtaining the ATIS	X			
26	Check ATIS content on TDLS	X			
27	NOTAMs in place and reviewed for accuracy	X			
28	Implement changes to surface surveillance (ASDE-X and/or AMASS) maps	X			
29	Implement Movement Area LOA	X			
30	Make necessary changes to IDS-4	X			
31	Update all Orders, Notices, LOA's, binders as needed	X			
32	**JUST SAY "NO"** - no last minute changes If airport (or contractor) fails to abide by the agreed phasing, FAA should request immediate meeting with airport sponsor;	X			

Taxiway Re-labeling Checklist

		Required	Status	Date Complete	Reason Not Accomplished
	Following Re-labeling				
33	Report out to the District Manager, Service Area Director, & Airport Construction Advisory Council (ACAC)	X			
34	Conduct surveys targeted at reviewing construction activities and mitigations to determine effectiveness of re-labeling Adverse trends and/or unsafe findings are reported to the ACAC	X			

Notes/comments:

Partial checklist from AC-150/5370-2 - "Operational Safety on Airports During Construction"

From AC 150/5370-2 - This checklist is intended as an aid, not as a required submittal.

Coordination	Reference	Addressed			Remarks
General Considerations					
Requirements for predesign, prebid, and preconstruction conferences to introduce the subject of airport operational safety during construction are specified.	205	☐ Yes	☐ No	☐ NA	
Operational safety is a standing agenda item for construction progress meetings.	205	☐ Yes	☐ No	☐ NA	
Scheduling of the construction phases is properly addressed.	206	☐ Yes	☐ No	☐ NA	
Any formal agreements are established.	205.c	☐ Yes	☐ No	☐ NA	
Areas and Operations Affected by Construction Activity					
Drawings showing affected areas are included.	207.a	☐ Yes	☐ No	☐ NA	
Closed or partially closed runways, taxiways, and aprons are depicted on drawings.	207.a(1)	☐ Yes	☐ No	☐ NA	
Access routes used by ARFF vehicles affected by the project are addressed.	207.a(2)	☐ Yes	☐ No	☐ NA	
Access routes used by airport and airline support vehicles affected by the project are addressed.	207.a(3)	☐ Yes	☐ No	☐ NA	
Underground utilities, including water supplies for firefighting and drainage.	207.a(4)	☐ Yes	☐ No	☐ NA	
Approach/departure surfaces affected by heights of temporary objects are addressed.	207.a(5)	☐ Yes	☐ No	☐ NA	
Construction areas, storage areas, and access routes near runways, taxiways, aprons, or helipads are properly depicted on drawings.	207.a	☐ Yes	☐ No	☐ NA	

Coordination	Reference	Addressed			Remarks
Temporary changes to taxi operations are addressed.	207.b(1)	☐ Yes	☐ No	☐ NA	
Detours for ARFF and other airport vehicles are identified.	207.b(2)	☐ Yes	☐ No	☐ NA	
Maintenance of essential utilities and underground infrastructure is addressed.	207.b(3)	☐ Yes	☐ No	☐ NA	
Temporary changes to air traffic control procedures are addressed.	207.b(4)	☐ Yes	☐ No	☐ NA	
NAVAIDS					
Critical areas for NAVAIDs are depicted on drawings.	208	☐ Yes	☐ No	☐ NA	
Effects of construction activity on the performance of NAVAIDS, including unanticipated power outages, are addressed.	208	☐ Yes	☐ No	☐ NA	
Protection of NAVAID facilities is addressed.	208	☐ Yes	☐ No	☐ NA	
The required distance and direction from each NAVAID to any construction activity is depicted on drawings.	208	☐ Yes	☐ No	☐ NA	
Procedures for coordination with FAA ATO/Technical Operations, including identification of points of contact, are included.	208, 213.a, 213.e(3)(a), 218.a	☐ Yes	☐ No	☐ NA	
Contractor Access					
The CSPP addresses areas to which contractor will have access and how the areas will be accessed.	209	☐ Yes	☐ No	☐ NA	
The application of 49 CFR Part 1542 Airport Security, where appropriate, is addressed.	209	☐ Yes	☐ No	☐ NA	
The location of stockpiled construction materials is depicted on drawings.	209.a	☐ Yes	☐ No	☐ NA	

Coordination	Reference	Addressed			Remarks
The requirement for stockpiles in the ROFA to be approved by FAA is included.	209.a	☐ Yes	☐ No	☐ NA	
Requirements for proper stockpiling of materials are included.	209.a	☐ Yes	☐ No	☐ NA	
Construction site parking is addressed.	209.b(1)	☐ Yes	☐ No	☐ NA	
Construction equipment parking is addressed.	209.b(2)	☐ Yes	☐ No	☐ NA	
Access and haul roads are addressed.	209.b(3)	☐ Yes	☐ No	☐ NA	
A requirement for marking and lighting of vehicles to comply with AC 150/5210-5, Painting, Marking and Lighting of Vehicles Used on an Airport, is included.	209.b(4)	☐ Yes	☐ No	☐ NA	
Proper vehicle operations, including requirements for escorts, are described.	209.b(5), 209.b(6)	☐ Yes	☐ No	☐ NA	
Training requirements for vehicle drivers are addressed.	209.b(7)	☐ Yes	☐ No	☐ NA	
Two-way radio communications procedures are described.	209.b(9)	☐ Yes	☐ No	☐ NA	
Maintenance of the secured area of the airport is addressed.	209.b(10)	☐ Yes	☐ No	☐ NA	
Wildlife Management					
The airport operator's wildlife management procedures are addressed.	210	☐ Yes	☐ No	☐ NA	
Foreign Object Debris Management					
The airport operator's FOD management procedures are addressed.	211	☐ Yes	☐ No	☐ NA	

Coordination	Reference	Addressed			Remarks
Hazardous Materials Management					
The airport operator's hazardous materials management procedures are addressed.	212	☐ Yes	☐ No	☐ NA	
Notification of Construction Activities					
Procedures for the immediate notification of airport user and local FAA of any conditions adversely affecting the operational safety of the airport are detailed.	213	☐ Yes	☐ No	☐ NA	
Maintenance of a list by the airport operator of the responsible representatives/points of contact for all involved parties and procedures for contacting them 24 hours a day, seven days a week is specified.	213.a	☐ Yes	☐ No	☐ NA	
A list of local ATO/Technical Operations personnel is included.	213.a	☐ Yes	☐ No	☐ NA	
A list of ATCT managers on duty is included.	213.a	☐ Yes	☐ No	☐ NA	
A list of authorized representatives to the OCC is included.	213.b	☐ Yes	☐ No	☐ NA	
Procedures for coordinating, issuing, maintaining and cancelling by the airport operator of NOTAMS about airport conditions resulting from construction are included.	208, 213.b, 218.c(3)(j)	☐ Yes	☐ No	☐ NA	
Provision of information on closed or hazardous conditions on airport movement areas by the airport operator to the OCC is specified.	213.b	☐ Yes	☐ No	☐ NA	
Emergency notification procedures for medical, fire fighting, and police response are addressed.	213.c	☐ Yes	☐ No	☐ NA	
Coordination with ARFF personnel for non-emergency issues is addressed.	213.d	☐ Yes	☐ No	☐ NA	

System Operations Services Checklists for Large Hub Construction

Runway Closure Delay Mitigation Checklist

Planning

Start Date	Action	POC	Description	Status
18 months	Define expected AAR/ADRs	ATCT/TRACON	Identify expected AAR and ADR for each configuration to use in modeling delay	Complete
18 months	Identify need for long lead time demand management initiatives (e.g., schedule changes)	FAA SOO	Model the effect of demand on expected arrival and departure rates; define and coordinate demand management needs	In Progress
12 months	Establish Delay Mitigation (DM) Team	MTO	Assign team including ARTCC, TRACON, ATCT, Airport Authority and Flight Operator representatives.	Complete
12 months	Develop contact list	MTO	Document DM Team members including name, organization, phone number and email address	Complete
12 months	Schedule meetings for all stakeholders	MTO	Plan DM Team meetings (at last once per month) to review action item status and identify items to resolve. Set up teleconference and web sharing capabilities, procure a room, projection equipment and telephone.	Complete
12 months	Develop and track actions to accomplish	MTO	Identify procedures & training and communications items relevant to project and include in a list defining needed actions, responsible organizations, due dates and status	In Progress
12 months	Provide construction status information	Airport Authority	Provide stakeholders with information about the construction schedule, changes and operational impacts. Review and update at each monthly meeting	On Going
6 months	Identify required airport modifications	ATCT/Airport Authority	Identify need to modify airport and surrounding areas (e.g., obstacle removal), plan to take action and follow up	Complete
3 months	Negotiate SAA Access	MTO/DCC	Identify special activity airspace access	W-105 Coordination Complete

Runway Closure Delay Mitigation Checklist

Procedures

Start Date	Action	Contact	Description	Status
12 months	Develop construction vehicle surface movement flow strategies	Airport Authority/ATCT	Develop and continuously monitor plan to segregate construction vehicles from movement area	Complete
12 months	Develop procedures to manage departure queues	ATCT	Identify methods for managing departure queue length (e.g., surface metering)	Complete
6 months	Identify surface staging locations	ATCT	Define planned staging locations	N/A
6 months	Identify surface metering "spots"	ATCT	Define planned surface metering locations	N/A
6 months	Determine optimal/maximum departure queue length	ATCT	Define optimum departure queue length used to manage aircraft entering queue	Complete
6 months	Determine manageable number of aircraft (arrivals and departures) for the movement area	ATCT	Identify optimum balance of arrivals and departures to occupy the movement area	Complete
3 months	Develop/Implement special/new procedures	ATCT	Identify strategies to manage different configurations (e.g., wake turbulence, etc.)	On Going
3 months	Develop VMC/IMC flow plans	ATCT/TRACON	Define planned air traffic flows for each configuration	Complete
3 months	Develop TBFM procedures	TRACON/ARTCC	Define TMA use plans to manage demand	N/A
3 months	Determine arrival/departure balance to maximize throughput	ATCT/TRACON	Define times to change airport configurations to manage arrival and departure pushes	Complete

Runway Closure Delay Mitigation Checklist

Training

Start Date	Action	POC	Description	Status
6 months	Develop controller training materials	TRACON/ATCT	Educate controllers on limitations and/or procedure changes due to construction - Include in controller training package	RECAT Training Underway
6 months	Secure ATCT simulator	ATCT	Obtain access to ATCT simulator to practice new procedures	Complete
6 months	Develop pilot training materials	A4A/RAA/NBAA	Educate flight crews on limitations and/or procedure changes due to construction	SOO/ACAC Reaching Out

Runway Closure Delay Mitigation Checklist

Communications

Start Date	Action	Contact	Description	Status
3 months	Develop/Submit NOTAM	Airport Authority	Include closure specifics and operations impacts - Submit to service center	End of Feb
3 months	Develop/Submit Impact Statement	TRACON	Provide closure and impact information according to JO 7210.3	Ready in Feb
3 months	Develop/Submit Letter to Airman	ATCT/Airport Authority	Describe closure, what pilots should expect and depict closed runway	Ready in Feb
3 months	Develop/Submit 'Closure for Construction' information to NFDC	ATCT/Airport Authority	Provide closure details for NFDC publication (Available, closed runway/taxiways, Hot Spots, staging areas, metering spots etc.)	Complete
3 months	Produce construction notice diagram	ACAC	(https://nfdc.faa.gov/portal/welcome.do)	Complete
3 months	Communicate closure to constituents	A4A/RAA/NBAA/AOPA	Provide constituents information about construction and reduced capacity. Advise of alternatives (e.g., reduce operations)	On Going
3 months	Provide surface flow plans	ATCT	Develop diagrams depicting planned surface flows, metering spots, and staging locations. Include strategies to manage different configurations (e.g., wake turbulence, etc.)	Complete
3 months	Provide air traffic flow plans	TRACON	Develop diagrams depicting air traffic flow plans for each configuration	Complete
1 Month	Establish procedures for and conduct daily planning telcons	MTO/ATCSCC	Discuss daily plan and need for initiatives among local FAA facilities, ATCSCC and customers	In Progress
1 Month	Complete and distribute playbook	MTO/ATCT/N90	Develop package that includes flow diagrams, planned procedure use, rates, special procedures, NOTAM, Letter to Airmen, etc.	In Progress
Daily	Develop daily plan and publish in an advisory	ATCT/N90/MTO/ATCSCC	Identify planned configurations and configuration change times	On Going

Runway Closure Delay Mitigation Checklist

Issues to Resolve

Action	Contact	Status	Due Date
Identify and track specific issues to resolve (e.g., obstacle removal, specific approach availability, etc.)			

Runway Closure Delay Mitigation Checklist

During Closure

Action	Contact	Description	Status
Assemble and provide after closure performance data	MTO	Assemble during closure metrics such as throughput, delays, holding, restrictions, plan compliance, etc.	Planned
Continue monthly meetings for all stakeholders	MTO	Conduct DM Team meetings (at last once per month) to review action item status and identify items to resolve. Provide presentations showing airport performance during construction.	Ongoing
Continue to track actions to accomplish	MTO	Continue to identify ant track items for resolution	Ongoing
Provide construction status information	Airport Authority	Provide stakeholders with information about the construction schedule, changes and operational impacts. Review and update at each monthly meeting	Ongoing