Approved by NextGen Advisory Committee October 2014

Blueprint for Success to Implementing Performance Based Navigation

Report of the NextGen Advisory Committee in Response to a Tasking from The Federal Aviation Administration

October 2014

Blueprint for Success to Implementing PBN

Contents

Background/Introduction

In December 2013, the Federal Aviation Administration (FAA) requested the NextGen Advisory Committee (NAC) develop recommendations as a follow-on to the previous recommendations on Performance Based Navigation (PBN).[1] The FAA requested the NAC analyze lessons learned from prior PBN implementations and develop a "blueprint," or checklist, for future success in PBN implementations.

This blueprint would cover the entire lifecycle, from planning to execution, and both technical and non-technical components, requiring the following key activities:

1. Identify all stakeholders needed and define their roles.
2. Describe specific outreach strategies associated with each stakeholder group to include development of a process/method to ensure stakeholder buy-in of project goals.
3. Describe specific possible outcomes and identify metrics for success.
4. Review existing process and incorporate lessons learned from previous and ongoing PBN initiatives, both domestic and international.
5. Develop a methodology to ensure lessons learned and expertise are captured and incorporated into future efforts.

Development of this blueprint will bring clarity to the PBN Implementation Process resulting in even greater success with future PBN efforts.

Executive Summary

The PBN Blueprint Task Group (Appendix A) is comprised of representatives from all stakeholder groups who have been engaged in PBN development and implementation, complemented by a diverse set of FAA Subject Matter Experts who have both led and made contributions to PBN efforts. This enabled the PBN Blueprint Task Group to achieve a holistic understanding of both the challenges as well as the opportunities for developing a PBN Blueprint Process.

This broader stakeholder set formed the basis for the first recommendation of the PBN Blueprint Task Group—that all PBN efforts identify and effectively engage all stakeholder groups, both technical and non-technical. Holistic engagement of all affected stakeholder groups, as well as establishing their commitment to adequately support the PBN effort is regarded as essential for ensuring the success of a PBN effort. In particular, it was recognized that airport operators should be engaged from the very beginning of the PBN initiative to provide input that would be used in formulating the overall goal of the PBN effort and the associated community outreach. Finally, it was concluded that PBN success is not solely dependent upon the FAA fulfilling all of its roles and responsibilities, but rather dependent upon all stakeholders fulfilling their respective roles and responsibilities in a collaborative and coordinated manner throughout the entire PBN process.

One of the guiding principles of the PBN Blueprint Task Group was avoiding recommendations that duplicate process, guidelines and efforts that are currently in place or under development (Appendix B).

[1] Letter from Michael G. Whitaker (FAA Deputy Administrator) to Margaret Jenny (RTCA President), dated December 20, 2013.

This is also an important principle for moving ahead with FAA actions as a result of these recommendations.

The PBN Blueprint Task Group used FAA Order 7100.41 as their baseline document, published April 3, 2014, which provides, "standardized five-phase implementation process related to Performance-Based Navigation (PBN) routes and procedures, referred to as the 'Performance Based Navigation Implementation Process'". The PBN Blueprint Task Group noted that a major limitation of this order is that it applies only to ATO (Air Traffic Organization) Service Units. This observation is related to the first recommendation; that FAA Order 7100.41 incorporates all recommendations contained within this document and be applied to the entire stakeholder community engaged in PBN development and implementation.

The establishment of an overall goal is essential to the success of any PBN effort. The goal serves to form the basis from which the anticipated outcomes and associated metrics are developed. The goal itself serves to align the expectations of all stakeholders, and thereby aligning their understanding and efforts to ensure the success of the PBN effort. Associated with this is the establishment of a designated organization to develop the overall data management plan which has the responsibility for all aspects of data management ranging from baseline data collection, analysis of post-PBN implementation data, and outcome reporting.

The PBN Blueprint Task Group, based upon its broad experience in developing and implementing PBN routes and procedures, noted vast improvements, in terms of efficiency and effectiveness, in the five-phase process approach to such efforts as compared with the eighteen step process previously followed. Such efficiencies and effectiveness gains were derived from both the capturing of lessons learned from prior PBN efforts and then applying these lessons learned to subsequent PBN efforts, forming in essence, a continuous improvement process.

The FAA directed the establishment of two tools: a Lessons Learned Database, for supporting general PBN efforts, and a Project Tracking Tool (PTT), for supporting larger scale Metroplex (formerly OAPM – Optimization of Airspace and Procedures in the Metroplex) PBN initiatives, with the intent of applying the lessons learned captured by each of these tools to subsequent PBN efforts. What the PBN Blueprint Task Group determined was that further refinement of both of these tools is required in order to promote understanding as well as wider dissemination/application of these lessons learned across all stakeholder groups. The refinement of these tools, coupled with the call for wider dissemination and timely application of lessons learned into subsequent PBN efforts, will require dedicated management and resources to support these activities.

The PBN Blueprint Task Group also identified the need to establish a Technical Stakeholder Outreach Effort so as to orient and empower first-time members of a PBN Working Group (WG) to effectively engage and contribute to the development and implementation of PBN routes and procedures. It should be noted that while a core group of technical stakeholders has been engaged in PBN efforts and is knowledgeable of the PBN process, there is a need to significantly increase the knowledge of the broad stakeholder community to effectively engage and contribute to PBN implementation. This effort should also include publicizing the availability of RNP approaches using the Automatic Terminal Information Services (ATIS) to enhance greater utilization of these high-value procedures.

The PBN Blueprint Task Group also identified the need to establish a more structured non-technical stakeholder community outreach effort that would parallel and support the PBN development and implementation effort. Such a need has been proven to be both beneficial and necessary in ensuring the

success of past PBN efforts. What has been lacking is a structured approach to engaging community support for PBN. The PBN Blueprint Task Group is recommending the development of a best practices approach to community outreach and stakeholder engagement that can be tailored to the scope and scale of a particular PBN effort. Airports were identified as a necessary participant in this process. Coupled with this is the recommendation to ensure that a high-level, post implementation analysis report be provided for informing local communities of the resultant benefits of PBN.

Consistency, efficiency and effectiveness are the desired outcomes of the PBN Blueprint process. As such, the PBN Blueprint Task Group recognized the essential value of the Metroplex PBN Development and Implementation Checklist, currently used to guide large-scale Metroplex PBN efforts for application to all PBN efforts. This checklist affords the PBNWG with the opportunity to tailor the comprehensive, individual steps of this checklist to satisfy the needs of the scope and scale of any particular PBN effort. It is important to note that this checklist will be updated from the application of lessons learned, captured by both the Lessons Learned Database as well as the Project Tracking Tool previously discussed. This ensures continuous improvement as the entire industry discovers more efficient and effective ways of implementing PBN.

Coupled with this more detailed checklist is the recognition that the overall PBN process, as directed by FAA Order 7100.41, should apply to the entire PBN stakeholder community, not just the ATO. As a result, the PBN Blueprint Task Group has developed an augmented process checklist that serves this purpose, and recommends that it be incorporated into FAA Order 7100.41.

All of these findings point to a level of maturity that the aviation industry, in partnership with the FAA, has achieved in developing and implementing PBN routes and procedures. The recommendations contained within this report, coupled with the tools and process refinements being developed by the FAA provide the basis for a PBN Blueprint Process that will enable not only near-term success, but more importantly, enable continuous improvement in the consistency, efficiency and effectiveness of future PBN efforts.

Methodology

To complete this initiative, the PBN Blueprint Task Group took the following steps in creating the recommendation:

- Reviewed the FAA Tasking letter to determine the scope of the request and the areas of expertise necessary to develop a recommendation.
- Identified the affected areas of PBN implementation and the tasking to ensure that the appropriate entities, organizations, and individuals were included on the Task Group.
- Developed an inventory of previous and current studies and reports (Appendix B) needed to garner the areas captured and avoid duplication (These are available upon request from RTCA).
- Established a set of Assumptions and Guiding Principles to guide its work and to provide a framework for development of the final recommendation.

- Sought input and guidance from the NextGen Advisory Committee at the Committee's February and June meetings, including a breakout discussion on the "Outcomes and Metrics for Success" associated with PBN implementation.[2]
- Received briefings from the following Subject Matter Experts (SMEs):
    - PBN Playbook – Jeff Woods, NATCA
    - Lessons Learned – Knowledge Repository – Jeff Davis, MITRE
    - PBN Implementation Experiences:
        - MSP – Jeff Hamiel, MAC
        - DCA – Brian Townsend, AA/US Airways
        - DEN – Mike McKee, DEN
        - SEA – Stan Shepherd, SEA & Lynae Craig, Alaska Airlines
        - PDX – Metrics – Post-Implementation Analysis Report - Lynae Craig, Alaska Airlines; Jason Schwartz, Port of Portland
        - PBN Accomplishments—Gary McMullin, Southwest Airlines
        - Metrics – Debby Kirkman, MITRE (Business Case Performance Metrics Work Group Co-Chair)
        - PBN Third Party Development – Paul Fillhart & Jay Rogers, Jeppesen; Hal Anderson, GE Aviation
    - Project Tracking Tool – Laura Rodriguez, MITRE
- Consulted and sought the advice of the NACSC who applied their expertise in the details associated with PBN implementations through unique briefings and discussions occurring from February through September 2014.
- Employed the FAA SMEs that worked very closely with the Task Group members to respond to technical and policy questions, as well as provided briefings in support of the analysis of technologies and capabilities.

[2] Highlights from the NAC discussion included the agreement of several key performance metrics, including: (1) predictability is crucial to the travelling public; (2) safety should be enhanced and must be continually evaluated; (3) usage of procedures should be tracked and documented; and (4) capacity and efficiency as measured by reduced fuel burn and block time are key metrics that should be continually measured. Specifically:

- Safety is an inherent part of the system. The Commercial Aviation Safety Team (CAST) is leading these efforts by taking a proactive approach that focuses on detecting risk and implementing mitigation strategies before accidents or serious incidents occur.
- Predictability is critical to the traveling public and aircraft operators. This can be measured by comparing planned trip segment times from block to block, by the actual time to complete the segment.
- Successful PBN implementation requires the need to balance capacity and efficiency and correlate this to fuel burn and block time.
- Tracking the percentage of use for a specific procedure and to what extent the pilot is allowed to navigate on it can help determine its effectiveness for ATC, but is not a definitive measurement of actual benefits to the operator or the system as a whole.
- It's critical to retain and improve access for general aviation at airports in proximity of air carrier airports where PBN is being implemented. This can be achieved by developing PBN procedures for the satellite airports as well.

Assumptions

The PBN Blueprint Task Group established the following Assumptions as a common understanding for its subsequent recommendations:

- Make use of existing FAA Orders, regulations and processes in order to achieve a common understanding.
    - Need to inventory the available information and documents as it pertains to PBN implementation.
- Recommendations may lead to changes in orders and guidelines to augment where necessary, but are not intended to create entirely new regulatory guidance.
- One size does not fit all in PBN implementation. While processes may be similar, circumstances vary.
- Identify and make use of common processes in the development and implementation of PBN procedures - looking ahead, as well as behind - for repeatable and predictable steps.
- Additional stakeholder engagement may be required to support PBN efforts including additional entities within the FAA, operators and airports.
- Make best use of existing milestones, organizations, and work plan structures:
    - Support existing processes in a synergistic and timely fashion.
    - Establish a framework for defining and describing resources that are needed.
    - Have a Task Group committed to offering process improvements.

Guiding Principles

The PBN Blueprint Task Group established the following Guiding Principles to provide the FAA with responses to the questions and issues requested by the Tasking Letter and Terms of Reference:

- Link actions and recommendations to specific PBN Tasking.
- Review unique implementations and develop procedures based on standard methods.
- Avoid recommendations that duplicate processes, guidelines and efforts that are currently effective and in place.
- Provide actions and recommendations for all appropriate stakeholders, not just the FAA.
- The types of procedures (En route vs terminal) and impacts on stakeholders and metrics will vary based on needs and expected outcomes.
- It is vital to reach agreement on the goals and objectives that the PBN procedure or initiative is designed to achieve, including all stakeholders points of view and interests.
- Stakeholders including communities, aircraft operators, airports, regulators, and aviation administrators, strive to achieve a consensus-based solution that benefits the national aviation system.
- The existing FAA Orders and Guidelines must be evaluated for effectiveness and applicability.
- Time and resource requirements must be considered, along with availability, when formulating actions and recommendations.
- Any findings, actions, or recommendations outside of the scope of the Task Group must be identified and described for FAA consideration.
- The goal is consistency when implementing PBN procedures.

Stakeholders – roles and outreach strategies

As noted in the recent NAC recommendation, Recommendation for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS),"Proper and efficient coordination and cooperation amongst the many stakeholders is the foundational requirement to addressing any of the other obstacles." The selection of level of engagement and timing of technical and non-technical stakeholders will vary by PBN project.

The Task Group determined that in addition to identifying all appropriate stakeholders, there is a need to develop an effective orientation to, as well as familiarity training for, stakeholders to ensure that they are able to effectively engage and support the overall effort. Findings are provided for both non-technical as well as technical stakeholders followed by recommendations which identify specific actions that should be taken to ensure accomplishment of this objective.

Non-Technical Stakeholders

Introduction

Historically, PBN projects have involved technically focused stakeholders including air traffic controllers, procedure designers, and aircraft operators. Although input from these experts is critical for successful outcomes of PBN projects, it is clear from past PBN projects that there is a broader group of stakeholders, including airport authorities, local and regional planning agencies, and community leaders, whose input is also critical for success.

This broader group can be loosely termed "non-technical stakeholders" insofar as they are not involved with the more technical aspects of aircraft performance, airspace procedure design or air traffic operations. Instead, these non-technical stakeholders are interested in the ultimate benefits associated with PBN procedures and addressing their environmental impacts[3], both positive (e.g., reduced aircraft emissions) and negative (e.g., concentration of aircraft exposure impacts).

[3] Thorough consideration of environmental impacts is an essential part of the development of PBN procedures. Timely completion of the environmental review process is fundamental for ensuring the efficient development of PBN procedures that address the needs of the operation. Environmental Assessments (EA) generally account for a twelve to eighteen month process to complete, and it's not uncommon for it to take longer. Environmental Impact Statements (EIS) are nominally three years to complete, but it is not unheard of to stretch to five years.

This lengthy process significantly delays and/or disrupts realization of the benefits stemming from PBN initiatives. Procedures can become somewhat outdated, as criteria are continually evolving. An extended environmental process could result in the need for a redesign.

This "barrier" to the implementation and usage of PBN has been identified in virtually every study or review of PBN processes, including the FAA's "Obstacles to Performance Based Navigation Implementation" and the FAA's "NAVLEAN" program. The need to address the issue of the lengthiness of the environmental review process was recently addressed in two RTCA NextGen Advisory Committee products, "Recommendation for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS)" and "CatEx 2: Recommendation for Implementing the Categorical Exclusion in Section 213(c)(2) of the FAA Modernization and Reform Act of 2012".

Key Non-Technical Stakeholder Groups and Roles

The following list is intended to cover the majority of Non-technical Stakeholder Groups:

Public

Potential contacts within the public sphere should include residents or communities which will be (or will likely perceive to be) impacted by the project. "Impacted" is defined by the individual and often goes beyond statutory impacts as defined by federal regulations. Concentrations of operations associated with PBN may not increase noise exposures at the levels outlined under the National Environmental Policy Act (NEPA), but can still be perceived as having an adverse effect on residential communities. In addition to engaging communities who will be impacted, residents or communities who will benefit should also be engaged. These may be areas that will benefit from less noise exposure, lower emissions, reduced concentration of overflight activity, etc. "Public opinion" should be driven not only by those who oppose the project, but should also include those who are neutral and support it.

Community Groups and NGOs

As a subset of the general public, community groups and non-governmental organizations (NGOs) are key entities to include. These groups can be organized and have established tools to engage larger groups within the community. They may represent a specific interest or have been formed based on reaction to previous events or changes. Community groups vary from region to region and can include formal or informal organizations based on geography (e.g. neighborhood or homeowner association) or a particular interest (e.g. airport-noise or community livability). In some communities, there may also be aviation industry or PBN experts that are impacted residents and engaged in the established community group. The broader community may already rely on these individuals for input and background on PBN. If present, they can be an important bridge to the community as a whole. NGOs can also be based on geographic areas or special interests and can be an important partner/liaison in helping bridge the gap between the larger community and their local airport, as well as helping industry better understand the community's interests and strategies for addressing those interests while meeting the needs of the NAS. An example of an NGO is the National Organization to Insure a Sound Controlled Environment (N.O.I.S.E.).

Airport Authorities

Collaboration with airport authorities is critical during all project phases including initial planning, design, implementation, and post-implementation analysis, because airport authorities serve as a bridge between the technical and non-technical stakeholders. Airport authorities are most familiar with local conditions, constraints, and relationships making them a key partner for effective community/public

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The recommendation on roles and responsibilities for key stakeholders, as well as the recommendations in the checklist that outline the timing and level of engagement, includes language that will enable the FAA to address one of the primary vulnerabilities in the current environmental review process. Informed and empowered stakeholders, coupled with well-structured and tailored community outreach programs, should reduce the disinformation and potential controversy associated with new procedures. These recommendations should support the FAA in expediting its review processes, allowing for thorough stakeholder engagement, and theoretically, more streamlined consideration of environmental impacts.

engagement. Airport authorities can be strong supporters and provide input on how to best conduct public engagement efforts as well as who specifically should be included in these efforts.

In addition to having relationships with local community stakeholders, airport authorities typically have relationships with industry stakeholders including airport tenants, airspace users, and air traffic control staff and management. Airports are also identified as a technical stakeholder to participate in the technical aspects of PBN development.

Airport Advisory Boards

Many airports in the US solicit input from Airport Advisory Boards when making decisions. These boards are typically made up of representatives from key stakeholders groups, including FAA/air traffic control, aircraft operators, and community leaders.

Airport Advisory Boards can provide additional resources for collecting local stakeholder input. Insights may include community interests and concerns, specifically those that relate directly or indirectly to PBN implementation, and recommendations to effectively engage local stakeholders. These boards and their membership/makeup vary greatly from community to community and should be viewed as one tool for understanding and engaging the community, but not as a replacement for wider outreach to all potentially impacted communities that may not be represented on a given advisory board.

Local, State, and Federal Government Officials

Government officials at the local, state, and federal levels should be engaged very early in the process starting with an effort to educate them about PBN and the value for the airport, community, the region, and the NAS. In many cases these projects remain a "local" interest, but with extensive or more complex projects, or initiative involving major airports or Metroplexes, and concerns from the community may be escalated to the state or federal level. In such cases, it is imperative that government officials be informed.

Outreach Strategies for Non-Technical Stakeholders

The needs for non-technical stakeholders in PBN development fall into three main categories education, engagement, and advocacy.

Education

Experience has shown there is a general lack of understanding by the public and elected officials of what NextGen and PBN is and is not. Often, opposition to a PBN project is based on misinformation and misunderstandings, reinforcing the need for education.

Initial efforts to educate interested non-technical stakeholders should begin early in the PBN procedure development. This provides an opportunity to discuss the potential benefits and trade-offs associated with PBN implementation. This activity can also demonstrate a commitment to transparency, as well as providing an understanding and consideration of the community's interests which can go a long way toward building trust and public acceptance. This may ultimately reduce potential project delays and increased costs resulting from community opposition.

A deep understanding of the "technical" aspects of PBN is not necessary for airport and community participants. However, a comprehensive knowledge of PBN operational aspects, as well as the implementation process, and stakeholder roles and responsibilities during the project cycle, is a necessary step in successful PBN implementation.

The local media plays a "sensitive" role in how information is presented to the general public. Media can help to build public support, or alternatively, public opposition to PBN projects and airports in general. Proactive efforts should be taken by appropriate representatives of the PBN Working Group (PBN WG) to engage and educate the media. Engaging the media effectively, by using appropriate representatives of the PBN WG, in addition to the FAA, helps ensure the PBN story focuses on the "big picture" of the NAS benefits. This also communicates the benefits and potential impacts for the local community. The media should be provided with the same message and background as the general public.

Engagement

Engagement includes outreach, communication, and collaboration in an effort to incorporate non-technical stakeholders' expertise, local concerns, interests, and potential impacts. Some PBN projects require specific public engagement activities as defined by the NEPA. Even in those instances when community engagement may not be a regulatory requirement, it is recommended that the community be recognized as a critical, non-technical stakeholder in PBN development. Outreach to the public should include a communication plan that provides a consistent message concerning PBN procedures. This may reduce the likelihood of issues arising during the operational preparation and implementation phases in FAA Order 7100.41. Ideally, this should be incorporated into the project planning, design, and implementation. Engagement activities may take many forms from traditional outreach including information sharing via the web and newsletters, community workshops and events.

Engaging all non-technical stakeholders (specifically established community groups and NGO's) proactively during the initial phase, Phase 1, offers the project team the opportunity to demonstrate a commitment to the community stakeholders, as well as industry stakeholders. It also provides an opportunity to educate local leaders on PBN and to gain a better understanding of local interests and potential concerns associated with PBN which can then be integrated in the PBN planning and design. Similarly to airport advisory boards, if these groups and the individuals involved are well-established within their community, they can be helpful in gaining public support for the project by serving as "ambassadors" to help with education and public comfort with the project goals. The airport can be a critical partner in leading this engagement.

It is important to note that "one size does not fit all", when it comes to outreach and education. Project specifics, including scope, complexity, and size will influence the level of engagement and determine which stakeholders to include, and which strategies should be employed. Projects that are expected to have a high impact (or the perception of high impact) will likely require more interaction than projects with minimal or no impact. Similarly, projects resulting in significant changes to flight paths (e.g., modifying flight paths over noise-sensitive areas, or changing the noise footprint in general), will typically require more engagement than projects with fewer procedures, procedural changes, or modifications relative to noise-sensitive areas.

Advocacy

The "Advocacy" role incorporates an understanding of the collective stakeholders' interests and ensures those interests are considered during the design and implementation. As with most projects of this nature, there are often trade-offs and compromises to be made. It is critical that the community's interests be considered and where reasonably possible, accommodated. Demonstrating this effort to consider the community perspective with the intent of incorporating it into PBN development process encourages trust and can reduce opposition. The overall goal and expected outcomes of the PBN project

will help determine what trade-offs can be made. The airport operator may be tasked with engaging the local community, identifying those interests and sharing them with the project team. Equally important, when engaging the community, the national interest and those of the industry stakeholders must also be communicated. It is critical that the interests of all stakeholders (technical and non-technical) are considered and balanced, consistent with the goals and prioritization developed for the PBN project. For some projects, reduction in environmental factors or noise may be the priority while in other cases the primary drivers may be capacity or access. The priorities may vary project to project. Part of "advocacy" includes maintaining a focus on the project goals and ensuring all stakeholders are aware of these, in addition to individual stakeholder interests.

Technical Stakeholders

The technical stakeholders should be available in all phases of the PBN process, from preliminary design through implementation and post implementation analysis. Technical stakeholders of the PBN Working Group are identified in Appendix A of FAA Order 7100.41, along with their roles and responsibilities. The list includes Proponents, Project Facilitators, TARGETS Operators, ATO Service Center Operations Support Groups (including Flight Procedures Team), Regional NextGen Branch, AeroNav Products, Industry Representatives, Air Traffic Facilities, Airport Authority, Flight Inspection Services, and PBN Policy and Support Groups.

Most of the roles and responsibilities of these stakeholders are clearly identified in Appendix A. However, further discussion and recommendations are provided for the Industry Representatives, Airport Authorities, and Air Traffic Facilities stakeholders.

The following descriptions include the outreach strategies for each stakeholder. Additionally, new technical stakeholders were identified including Pilot Unions, Department of Defense, Third Party Procedures Developers, and others.

Industry Representatives

The expansive deployment of PBN necessitates the involvement of a broader spectrum of industry technical stakeholders. Air traffic management in the NAS must be agile enough to provide a wide array of service to operators with varied capabilities. These capabilities vary due to aircraft equipage, pilot and ATC training, and available supporting automation. The importance of Industry engagement to account for varied capabilities cannot be over emphasized. Because core capabilities may not be the same at different airports, the type of PBN implementations may be very specific at a given location. For example, the concept of operations for one airport could include the use of RNAV RNP AR, while another's would support basic RNAV. As a result, key industry stakeholders should be identified and their role clearly defined and applied. The following stakeholders and their roles should be adapted as part of the PBN Blueprint:

<u>Lead Operator</u>

For several years, the PBN process has relied on a "Lead Operator" concept that designates a primary airline to be at the table throughout the design and implementation process in order to provide the flight operations perspective. This has proven to be a key component in beneficial and successful PBN deployment. The legacy 18-Step Process for PBN development provided a basic framework and recommendation for lead operator roles and responsibilities.

The lead operator is tasked with many responsibilities throughout the process. Outreach and coordination between the industry stakeholders and the FAA is a prime task. The lead operator will primarily focus on airspace and procedures that have a direct impact on their operation, but additional operators may participate in order to represent their interests as well. The lead operator should also provide the technical operational aspects of procedure design, aircraft FMS, and automation systems.

The lead operator should disseminate procedure and route data to other operators for review and simulation in additional aircraft types, ensuring that the Flight Simulator Worksheet is submitted to the project facilitator and distributed to other operators. The lead operator should also coordinate simulator and flight crew simulator evaluations, with the FAA Regional NextGen Branch (RNGB) and, as appropriate, with the FAA Principal Operations Inspector (POI).

Some implementations require the need for advance notification to flight crews, as they can represent a significant change to operations in the respective airspace. The lead operator should work with industry stakeholders to develop briefings and bulletins related to PBN initiatives and implementations and coordinate the dissemination of the material. The lead operator will also perform the role as primary industry representative for PBN implementations.

Controller education has proven to be a significant factor in successful implementations and ensuring operational issues are mitigated. Operators that provide controller outreach and briefings have experienced positive feedback and improved acceptance of the procedures. Until such a time when PBN is “routine” in the NAS, operators should be encouraged to provide briefings and education to controllers in advance of major initiatives.

Airlines for America (A4A)

The member airlines of A4A are increasingly aware they must work closely together in the NextGen arena in order to deliver a consistent and coordinated message to the FAA. There are many aspects to procedure design, including new concepts and operational philosophies. A4A should strive to deliver an aligned voice, as it relates to PBN design and implementation projects and overall operational policies. A4A can be a central source of communication and a resource for the FAA during the PBN process.

The PBN Blueprint Task Group identified the following roles for A4A:

- Coordinate with member carriers to assign Lead Operators to PBN projects and notify the FAA.
- Help assure representatives are qualified for technical and operational aspects of the project. Due to the technical nature of the PBN initiatives, airline representatives must have a thorough understanding of air traffic and airspace structure. Aspects of procedure design and criteria are necessary. The representative must possess operational knowledge and experience with flight management systems of air carrier flight decks, as well as PBN operations.
- Coordinate with Airline ATC representatives and Dispatchers through the Air Traffic Management Council to ensure there is connectivity with the operational needs of the air carriers, as well as coordination with the implementation process. In addition, airline ATC representatives may provide support during the design process, as they are usually very knowledgeable of airspace and air traffic considerations.
- Coordinate with the industry Technical Pilot Work Group (TPWG) through the Airline Operations Committee (AOC). The Technical Pilot Work Group consists of several technical pilots from the A4A member airlines, as well as pilots from labor groups, business aviation, and regional airlines. A4A can leverage this group as a central source of information sharing and coordination

throughout the process. The AOC will provide the appropriate oversight and coordination with the Technical Pilot Work Group, including other applicable A4A committees.

- A4A, in coordination with the Lead Operators, should provide the means for consistent communications between the FAA and the member airlines for PBN implementations.

National Business Aviation Association (NBAA)

The NBAA continues to evolve into an ever-increasing component of PBN throughout the NAS. Most business aviation aircraft are equipped with sophisticated avionics and flight systems that enable most PBN applications. They are able to leverage procedures at major airports, as well as the hundreds of airports that the air carriers do not serve.

Major PBN projects now include numerous satellite airports that are of particular interest to business aviation operators. The focus is no longer entirely on the primary airports, PBN arrival and departure procedures are now becoming part of the overall airspace development. The NBAA should be included in projects where their members are directly impacted.

In most cases, NBAA does not have the resources to take on a Lead Operator role, but it is effective in communicating planned PBN projects to members, and is able to provide technical support when possible. They can also act as a communications conduit for outreach to the business aviation community. The NBAA can provide technical input on PBN projects at airports and Metroplexes of interest to business aviation operators.

Regional Airlines Association (RAA)

As PBN continues to proliferate, procedure development can be directly impacted by the limited equipage capabilities of the current regional fleet. Using the "best equipped, better served" philosophy could dramatically impact traffic management and host air carrier schedules[4].

The technical role of the RAA should include coordination with member carriers to provide Regional Air Carrier representation with PBN initiatives where they are impacted. In some cases, the regional operator may be assigned the Lead Operator role, if appropriate.

The RAA should help assure representatives are qualified for technical and operational aspects of the project. Realizing their resources are constrained, it may be necessary for the host carrier to work closely with the Regional or Express carriers to make certain their fleet capabilities are compatible with the intended procedures and airspace redesign.

Similar to A4A, the RAA should develop an aligned Regional Carrier voice for PBN projects. Delivering a consistent message to the FAA can aid in the overall success of PBN.

Airport Authorities

Many airport authorities have technical expertise on their staff that could facilitate implementation of PBN procedures. Airport organizations differ significantly, so technical representation could come from one or more of the following departments or divisions:

- Airport Planning and Development
- Airport Operations

[4] Referencing Summary of the NextGen Advisory Committee Discussions, Best Capable Best Served, Non-technical Barriers to NextGen Implementation, May 2012.

- Airport Noise Abatement Office
- Community Affairs/Public Relations
- Airport owner (e.g., city, county, state, or authority) departments such as planning and development, legal, and zoning

In addition, many airports have long-standing local organizations responsible for coordinating operational improvement projects (e.g., PBN) and have developed successful working relationships with local and regional air traffic facilities, airlines, other airport users, and other local planning organizations.

Their primary role could be expanded beyond that identified in Appendix A. As noted in the non-technical stakeholder section, Airports serve as a bridge between the PBN Work Group and the community stakeholders. Airports provide essential information about their prior and ongoing plans and programs that could affect, or be affected by, PBN implementation, such as the following:

- Existing or proposed noise-abatement flight procedures
- Environmental Impact Statements/Environmental Assessments
- Prior agreements with surrounding communities
- Airport Master Planning, Part 150, and relevant prior operational studies
- Existing and planned infrastructure, development programs, and zoning ordinances
- Airfield operational constraints and modifications of airport standards

Air Traffic Facilities

Lessons learned from previous PBN implementations highlight the importance of ensuring there is a proper analysis to forecast the systemic effects of new PBN operations. Appropriate modeling must include the broader Air Traffic Management (ATM) ramifications prior to implementation, and identify necessary mitigations. In most cases, complex PBN implementations will affect adjacent ARTCCs and the impact of new procedures on potential flow restrictions/considerations. If this is the case, those ARTCCs must be included as stakeholders during all phases of the PBN project.

Newly Identified Technical Stakeholders

The following technical stakeholders are identified for inclusion in Appendix A of FAA Order 7100.41:

Pilot Unions

The safety structure of pilot labor organizations can offer a tremendous resource for flight deck operations perspectives and all aspects of technical expertise related to PBN. As part of the PBN Blueprint, pilot unions should be invited to participate in PBN initiatives.

Pilot unions are encouraged to provide qualified technical and safety representation. They can provide expertise in multiple aircraft types with varying performance and avionics capability. Their safety driven culture can assist with identifying known or potential safety issues related to the PBN project. They may also provide valuable support in identifying lessons learned from previous initiatives.

Safety representatives have also worked with project members to solve or mitigate issues on numerous occasions. They have the network and capability to disseminate information to large pilot groups related to procedures and implementations.

Department of Defense –DoD

The DoD performs unique operational missions in both Special User Airspace (SUA) and other non-SUA airspace that require close coordination in the development of PBN projects in order to preserve mission capability. SUAs and low-level training routes are highly utilized tools the DoD needs in order to ensure mission readiness. When development of PBN procedures have the potential to operationally impact, conflict, or lie within close proximity to DoD missions or SUA, the DoD must be consulted and provide technical input to ensure all operational impacts are accounted for, understood and mitigated.

The collaboration between the FAA PBN project leads and DoD representatives is essential to the success of both groups. National and regional DoD airspace representatives must make every effort to assist the FAA in securing appropriate DoD participation in PBN implementation efforts. The DoD must provide a qualified technical representative or a designated point of contact that can act as a communications conduit for DoD branches to the max extent possible.

Third Party Procedures Developers

Third parties are currently being used successfully to design and implement PBN-based Instrument Flight Procedures (IFPs) on a limited basis throughout the NAS, and have demonstrated the ability to do this work in accordance with all relevant regulatory requirements. As the demand for designing and implementing PBN IFPs increases, it is the view of the Task Group that qualified third parties can be used to augment existing resources with the goal of optimizing the design and production rate of these procedures.

Over the past 10 years third parties have made significant investments to build multi-domain capabilities, expertise, and experience working with the stakeholders described in this document. Third parties are able to provide capabilities across all PBN IFP design elements. These capabilities range from single domain expertise (such as electronic navigation data coding requirements) that can augment the procedure design process, to fully managing and executing all elements of a PBN design and implementation program, following the design and development process as outlined in FAA AC 90-110, and the Instrument Flight Procedure Validation process as described in FAA AC 90-113.

Specific demonstrated capabilities include, but are not limited to, the following:

- Development of an Implementation Plan in accordance with AC 90-110
- Coordination Activities with relevant technical and non-technical stakeholders described in this document
- Facilitation and management of stakeholder meetings and activities per FAA Order 8260.43
- Development of the IFP in accordance with relevant FAA Orders, including environmental review (FAA Order 1051.1), procedure design (FAA Order 8260.58), and the support of the administration and accomplishment of flight procedures and airspace (FAA Order 8260.19)
- Development and delivery of a training package for use by Air Traffic Controllers
- Conducting the Instrument Flight Procedure Validation (IFPV)
- Pre- and Post- Implementation Support
- Program Management Activities

- Maintaining a Document Management System that allows for continuously updating all internal processes with changes to regulatory requirements

Since 2003, many countries, including Australia, Canada, Malaysia, New Zealand, and others, have successfully used third parties as fully delegated (or through other similar agreements) organizations to design, implement and maintain PBN-based IFPs. These IFPs include SIDS, STARS, approaches, and En route segments designed in full compliance with all relevant ICAO documents. As fully delegated organizations, third parties accomplish all elements of the design, implementation, and on-going maintenance process, with the regulators acting in an oversight and auditory role.

Other Technical Stakeholders

Each PBN initiative should consider other technical stakeholders that are not always required to be at the table throughout the process, but may provide technical knowledge and support related to their areas of expertise, or that may have a vested interest in the outcome of the project. At a minimum, this should include an opportunity for input by:

- Non A4A/RAA airlines/operators
- International Air Transport Association (IATA)
- Aircraft Owners and Pilots Association (AOPA)
- Database and charting providers
- Aircraft and Avionics manufacturers

These groups should formally respond to the PBN Working Group as to their interest in participating in the process as well as to providing timely input that enables the efficient execution of the PBN development effort should they have declared an interest in the particular PBN development effort.

Recommendations for Non-Technical and Technical Stakeholders

An overarching principle for any PBN implementation is the importance of each stakeholder involved acting on the specific recommendations made by the PBN Working Group.

Non-Technical

1. Non-technical issues—particularly potential (or perceived) noise and/or community impacts associated with proposed PBN implementations—should be evaluated from the outset of implementation planning efforts. The evaluations should include the populations and political jurisdictions affected by anticipated changes in flight track centerline locations (both lateral and altitude changes), aircraft dispersion around the centerlines, and anticipated changes in runway use at the affected airport(s). Potentially “impacted communities” should be based not only on federal (e.g. NEPA) standards, but should also include communities likely to “perceive” changes in impacts, whether or not they meet/exceed NEPA standards. Community opposition to PBN can result in increases (or perceived increases) in noise or changes in overflight activity which can delay/derail PBN projects whether or not federal standards are exceeded. A proactive approach to community engagement is recommended to ensure project success.
2. For PBN projects involving airspace procedure changes at or near airports, community concerns should be considered during the PBN development process. Each project will differ in scope and level of outreach required. Community engagement should go beyond “public awareness.”

Airport authorities should be viewed as the lead non-technical stakeholder of first resorts in these cases and should assist in identifying other key non-technical stakeholders—including community organizations, NGOs, and others—that should be involved in the PBN planning and development process. Such groups may include established community advisory groups, airport/community "roundtables", or similar stakeholders. The non-technical stakeholder role and level of involvement will also vary based on project complexity, potential impacts, and other factors.

3. PBN implementation efforts should include plans for education, engagement, and advocacy on behalf of technical and non-technical stakeholders that takes into consideration local community interests as well as those of industry and the NAS.

Technical

1. Technical stakeholders must cross all organizational lines of business within the FAA. FAA Order 7100.41, PBN Implementation Process, is an ATO policy document. Because the ATO has no authority over the Aviation Safety (AVS) organization, which includes Flight Standards it is challenging to implement any new PBN procedures without continual coordination of the technical stakeholders from both of these organizations. A broader cross cutting policy needs to be adopted that ensures all FAA representation is working from the same foundational guidance.
2. To provide a consistent and repeatable process, the role of the lead industry representative should be more defined as part of the PBN Blueprint. PBN is not specific to airline operations and could potentially include an operator that is not necessarily a major air carrier. As such, "Lead Operator" should become the official reference for the lead industry representation in PBN projects.
3. The Task Group recommends the FAA take appropriate action to develop a national standard for controller education and outreach. A program of this type can be pivotal in reducing cultural barriers and the resistance to change that can extend the timeline of projects, and in some cases, completely stop an initiative.
4. An important issue in transitioning from legacy voice communicated clearances and routing that rely on ground-based navigational aids to a performance-based En route and terminal structure is leveraging the capability for equipped operators. The current level of equipage in the system has not attained a "critical mass" that seamlessly permits controllers to issue RNP approaches as the rule. There will be a time where the equipage level permits the routine use of RNP throughout the system. Until then, the challenge is finding ways to increase the use of RNP where it is currently in place. An effective tool in addressing this is adding the availability of the procedure on the ATIS broadcast for the airport. There are a number of RNAV STARs that contain chart notes advising the pilots to "Expect the RNP Approach," for those that are equipped. This is another effective way to encourage the use of RNP. The PBN Blueprint Task Group recommends that the FAA use the ATIS as a means to advertise the availability of RNP approaches.
5. Airport technical stakeholders should be consulted early in the PBN implementation process and participate in each step as a member of the PBN Work Group. Their role as a bridge in the

community should be expanded beyond that currently identified in the Order as both a Non-Technical and Technical Stakeholder.

6. In order to ensure local DoD support for a particular area, FAA PBN project leaders must contact national and regional DoD airspace representatives listed in Appendix D.
7. Newly identified technical stakeholders should be included in the PBN Work Group: Pilot Unions, Department of Defense, Third Party Procedure Developers (where appropriate), and Non A4A/RAA airlines/operators, IATA, AOPA, Database and charting providers, and Aircraft and Avionics manufacturers.
8. An analysis of the impacts on adjacent ARTCCs and the impact of new procedures on potential flow restrictions/considerations should be conducted for complex PBN implementations. If an impact is identified, affected ARTCCs must be included as stakeholders during all phases of the PBN project.

Outcomes and Metrics for Success

Background

The PBN Blueprint Task Group received briefings on a number of PBN implementations that appeared to have different primary goals. What varied between each PBN implementation was the amount of clarity, transparency, and stakeholder agreement regarding what the goal(s) of the effort was. Furthermore, it was observed that defining clearly stated and agreed upon goals at the outset of an implementation effort, provided the PBN WG with the necessary focus for developing objectives as well as associated metrics for measuring and achieving the objective(s).

For purposes of clarity and consistency in this report, the PBN Blueprint Task Group recommends the following terminology convention:

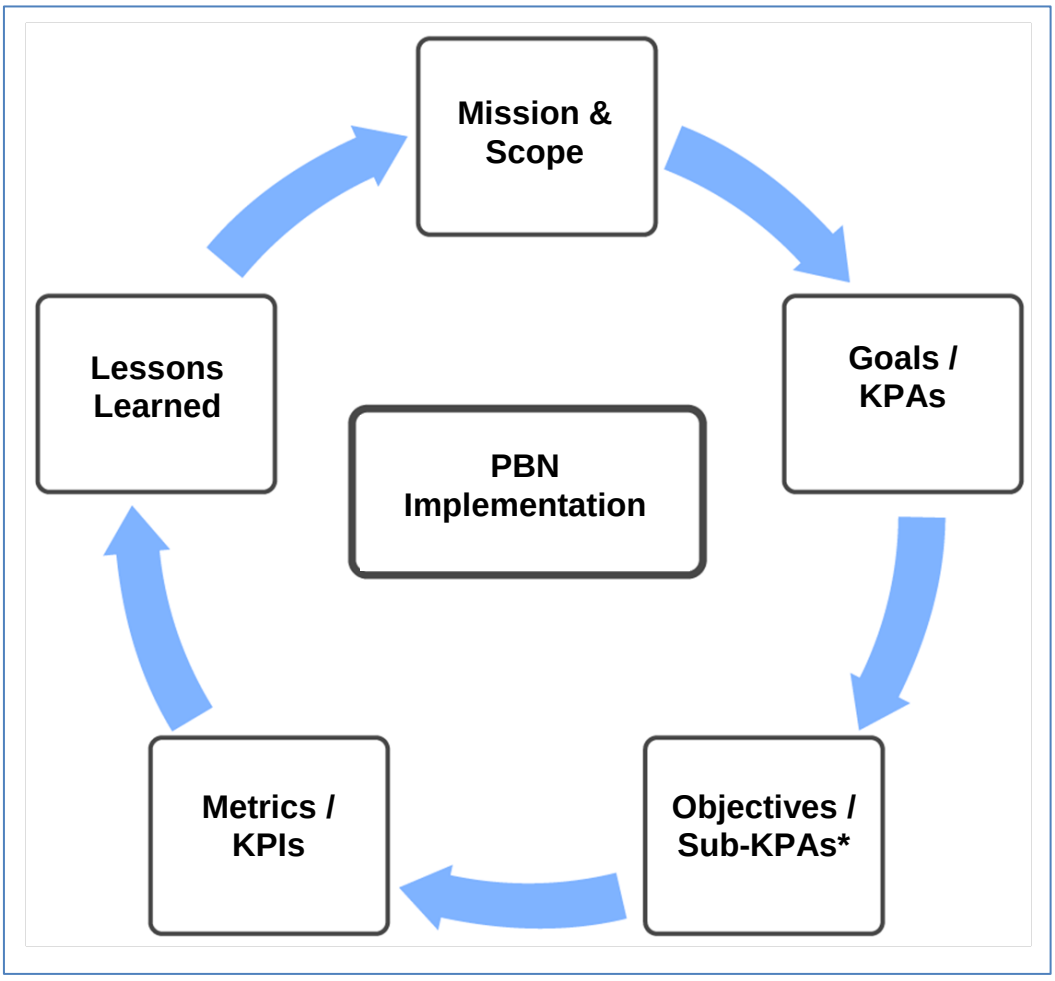
- **"Mission and Scope"** is a narrative summary of the overall purpose of the PBN project and a description of the individual procedures to be implemented
- **"Goals/KPAs"** describe the high-level outcomes the PBN project is trying to accomplish in terms of Key Performance Areas (KPAs).
- **"Objectives/Sub KPAs"** are the precise results that support the achievement of the goals of each PBN procedure. Objectives should be realistic, measurable, include target completion dates, and specify the KPAs to be measured.
- **"Metrics/KPIs"** comprise a set of Key Performance Indicators (KPIs) that will be measured regularly to track progress toward achieving the objectives.
- **"Lessons Learned"** document the degree to which the various goals and objectives were achieved, along with any issues, anomalies, and areas of possible improvement.

The relationships among these elements of the PBN implementation process are summarized at a high-level on Figure 1, which shows the cyclical relationship among the elements of the process. The intent of this cyclical relationship is to foster continuous improvement in the PBN implementation process.

The relationships shown on Figure 1 are applied at both the national and the local levels. The local PBN project working group should show the relationship between the local goals and KPAs and national PBN and NextGen goals and KPAs.

The PBN Blueprint Task Group also observed that having differing (sometimes even conflicting) goals for a PBN implementation also implies that measurable objectives will need to be defined for each specified goal. Also, inferred from this is that a "trade-space" or "trade-off" between goals and associated objectives will need to be developed by the PBN development team that stakeholders both understand and agree upon at the outset of the development effort.

Figure 1
PBN Blueprint for Success
Continuous Improvement Cycle



*Objectives should be realistic, measurable, include target completion dates, and specify the KPAs to be measured.

Building upon previous metrics work completed by the Business Case & Performance Metrics Work Group (BCPMWG), the PBN metrics sub Task Group identified all the key performance areas relating to PBN implementation. These have been mapped out against the five (5) PBN implementation phases outlined in the FAA Order 7100.41.

While most key performance areas will apply to any PBN procedure as implemented, the indicators will vary and inform various stakeholders. Although a work in progress, the PBN Blueprint Task Group has identified several indicators for each performance area additional to FAA Order 7100.41.

Measuring change through specific outcome metrics will define success in PBN implementation. Fundamental to any change are baseline goals measured against primary objectives. Goals however can and are expected to be different when, for example, demand exceeds capacity. Capacity should not be decreased, as Traffic Flow Management (TFM) is a primary metric while flight efficiency is secondary. Some flight efficiency metrics should be retained such as increased access during lower weather minima and decreased during fuel burn.

Because different stakeholders will need different sets of informing analytical data, the level and scope of PBN metrics (as indicators), will be different. The PBN Blueprint Task Group wrestled with creating a one-size-fits-all set of metrics. Each PBN implementation location will vary by type and procedure requiring a unique set of metrics. The PBN Blueprint Task Group identified a larger set of PBN Implementation metrics organized by phases of implementation, from which to select. They are contained in the Master PBN Implementation Metrics Spreadsheet Appendix E and available from RTCA upon request.

Findings

1. No one metric or set of metrics fits all PBN implementation projects, because different projects have different goals and stakeholders. The selected metrics should be aligned with the established stakeholder goals for the proposed PBN procedure development effort. Therefore, it is important to establish clear goals and measurable objectives or performance targets at the outset of the PBN implementation process.
2. For all PBN procedures, flight safety is the primary Key Performance Area (KPA). This KPA is currently being tracked by the FAA. Safety is a core requirement for the development, design, and implementation of all IFPs. They must meet an established equivalent level of safety for each flight domain. A key understanding throughout this document is the acknowledgement that all IFPs (En route, terminal and approach) must comply with this core requirement.

   As noted in FAA Order 7100.41, “This order provides a standardized five-phase implementation process related to Performance-Based Navigation (PBN) routes and procedures, referred to as the ‘Performance Based Navigation Implementation Process,’ which has been deemed compliant by the Office of Safety and meets the requirements set forth by the Federal Aviation Administration (FAA) Air Traffic Organization's (ATO) Safety Management System (SMS).”

   For the purpose of establishing a clear understanding of the role of safety throughout this document, the reader should know the following key safety points:

a) Safety is paramount in all matters pertaining to this document (e.g., assumptions, guiding principles, recommendations, etc.).
b) All references to improvements or enhancements in safety do not imply that the procedures are inherently unsafe or existing "target levels of safety" are insufficient; only that these improvements are to be considered extensions of the existing safety requirements.
c) Stakeholders play a key role in ensuring of aspects of safety are considered, evaluated, and implemented as required.

In addition, the PBN Blueprint Task Group identified additional KPAs[5] related to FAA Order 7100.41: Operational Efficiency, Fuel Efficiency, ATC Cost Efficiency, and Metroplex Access. These are informed by diagnostic metrics or Key Performance Indicators (KPIs). The KPIs can measure change in fuel burn, noise, carbon-footprint, ATC and flight crew workload, and time in the air. These KPIs may demonstrate how a PBN procedure is a benefit to technical and non-technical stakeholders, but may entail explaining the trade-offs (e.g. Distance may be reduced, but not assured).

3. Schedule integrity[6] is crucial to the airlines and traveling public – like access is for the nonscheduled operators. By capturing the impact of each implementation category (by phase), then comparing it to the initial PBN goals – incremental improvements can be measured, schedule integrity ensured, and predictability monitored. Well-informed project managers and aggressive stakeholder involvement will augment and maintain fair weather flow rates at each location.
4. New PBN procedures should facilitate air traffic control functions, enhance operator efficiencies, sustain or increase airspace throughput, improve access (for scheduled and non-scheduled operators), and increase predictability. KPIs can measure these incremental improvements and serve as the basis for comparison with the established stakeholder goals for the new procedure(s).
5. PBN Implementation metrics can be measured at a Runway, Airport, Metroplex (to include satellite airports), or the NAS, depending upon the procedure and the target audience.
6. There is nearly always a "burn-in" phase during which pilot and controllers need to become familiar and comfortable with the new procedures. There may be significant trade-offs between certain metrics during this burn-in phase in order to safely conduct the required training and familiarization of controllers and pilots initiating the procedure. For example, controllers may decide that it is necessary to introduce in-trail separations between arrivals when a new PBN procedure such as an Optimized Profile Descent (OPD) is first implemented. Historically, these initial in-trail separations usually can be reduced back to be close to normal as controllers and pilots become accustomed to the new

[5] The *Metroplex Capacity* KPA is outside the scope FAA Order 7100.41

[6] "For the purposes of this document, schedule integrity is defined as and specific flight meeting its proposed departure and arrival schedule, and completing all of those flights 100% of the time."

procedures, thereby reducing or eliminating the trade-off between throughput and efficiency. The length of this burn-in phase may vary depending upon the particular PBN procedure being implemented; therefore, it may be prudent to monitor certain metrics during the burn-in phase to determine when the trade-offs are eliminated or reduced to an acceptable level.

7. Beyond the burn-in phase, trade-offs may persist or even be expected after the PBN procedure reaches a steady state. For example, a new PBN procedure that is intended to increase arrival efficiency may involve crossing arrival and departure paths, requiring level-offs and in-trail separations to de-conflict the paths and manage the flow. If such a steady-state trade-off between capacity and efficiency cannot be fully mitigated, then further analyses may be required to evaluate whether the new PBN procedure provides a substantial net benefit that is acceptable to the stakeholders at a particular airport.

Recommendations for Outcomes and Metrics

One of the PBN Blueprint Task Group's assumptions was that no one metric or set of metrics fits all PBN implementation projects, because different projects have different goals and stakeholders. The recommendations of the PBN Blueprint Task Group are summarized below:

1. Metrics should be aligned with the goals and objectives of the PBN procedure identified in the Preliminary Work phase of a PBN project. This results in the metrics having real meaning to all stakeholders. Moreover, the selected metrics should be re-evaluated at each project phase and then periodically beyond Post Implementation, which will result in more subtle issues and concerns being captured. As an example, controller and pilot user experience and acceptance takes time, and will not be faithfully captured by a singular data gathering event.
2. Each PBN project should begin by restating the goals and objectives for a PBN procedure. Measureable objectives or targets should be tracked in each phase, and specific metrics should be selected to measure achievement of the objectives and inform project managers. The project is complete once the lessons learned of each implementation phase are documented, and the Post Implementation Reports are published. To ensure stakeholder involvement and buy-in, project managers with input from the project team, should select applicable KPAs and KPIs from the Master PBN Implementation Metrics Spreadsheet to supplement FAA Order 7100.41.
3. As part of the considerations for the Phase 1 Baseline Analysis Report (BAR), baseline data reflecting the existing status of procedure(s) should be used to inform the selection of metrics intended to be used for data collection and later analyzed to compare outcomes to existing status. The overall data management needs to be consistent, effective and demonstrate a clear relationship between pre and post implementation of a PBN procedure.
4. A prototype exercise should be completed to ‘test’ the KPAs and KPIs identified in the Master PBN Implementation Metrics Spreadsheet. As diverse and inclusive PBN projects are brought online; the Master PBN Implementation Metrics Spreadsheet and FAA Order 7100.41 can be updated. It is recommended the FAA could begin with a PIAR (see 5 below), based on an existing completed PBN implementation that was considered to be

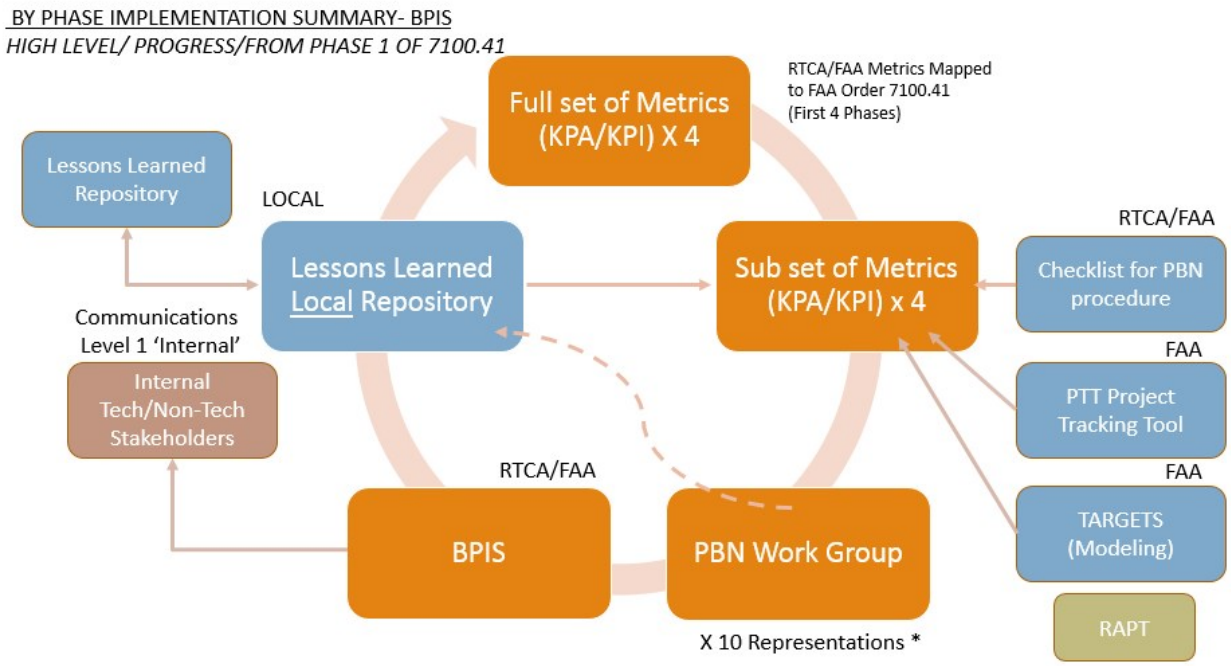
successful and not complex. Appendix C includes a Draft PBN PIAR (at Phase 5) that for this instance was provided and presented to the WG by Alaska Airlines and Port of Portland. This partial analysis identifies both KPAs and KPIs, all but one of which can be informed by a reasonable degree of data gathering and further analysis. From this prototype effort lessons learned may be derived and retained in a Lessons Learned Repository for future access by other PBN implementation stakeholders.

5. The FAA PBN Order calls out for a Post Implementation Analysis Report (PIAR) and also progress data is entered into the PTT during each of the 5 phases of an implementation. The PBN Blueprint Task Group considers it important to tie the PTT phase data and the post implementation report together by creating the building blocks for the PIAR commencing at Phase 1 of a PBN project. The future contents of the PIAR will be developed in a cumulative fashion as the PBN proceeds such that by Phase 5 there will be in essence, a good summary including a set of lessons learned. In fact at the end of Phase 5 the primary outstanding action items will be centered on outcomes and metrics based on data derived from the operation and use of the fully implemented PBN.

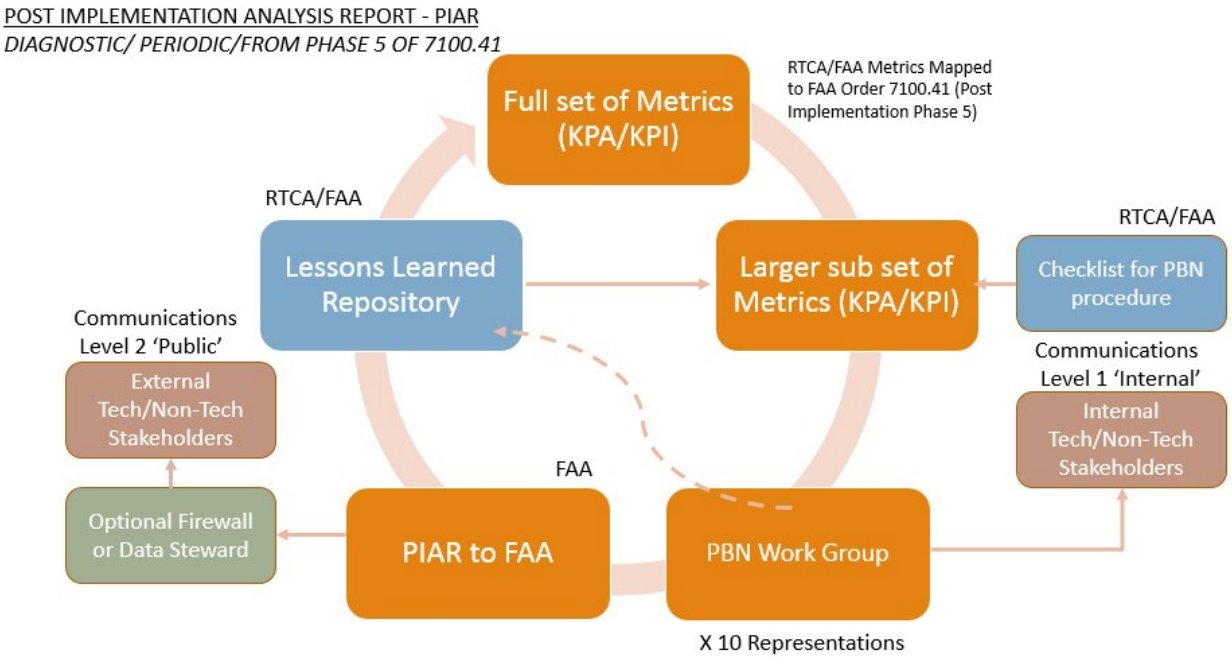
   The PBN Blueprint Task Group recommends two (2) different reports, during and post PBN implementation. 1) By Phase Implementation Summary (BPIS) for Phases 1-4. 2) The existing Post Implementation Analysis Report (PIAR) that is part of Phase 5. Critically the PIAR remains 'in-progress' at the later stages of Phase 5 but may be usable as a summary to be shared between the internal stakeholders, including across FAA departments. Because it is a summary and not the final report, it should remain within the data repository, externally accessible via the FAA as de-identified lessons learned for other PBN Work Groups.

   Report (1) – Implementation Summary – A By Phase Implementation Summary (BPIS): This is a brief high-level report specific to each phase (1-4), of a PBN project. The corresponding metrics template will vary by type, location, and phase of procedure implementation.

   The BPIS should be a concise report summarizing the current status of PBN Implementation process. Depending on the audience, it should be written as an internal report for both the FAA and local stakeholders. The BPIS should continually link the Initial goals and objectives with phase outcomes. It should identify the key stakeholders and their roles, as well as KPAs and KPIs selected to evaluate the process for each phase. The BPIS should outline the data sets and data sources required to inform the KPAs. Included in the BPIS would be lessons learned from each phase and any trade-offs identified. ***The Metrics PBN Blueprint Task Group recommends using the Master PBN Implementation Metrics Spreadsheet to create the BPIS.***



Report (2) – A Post Implementation Analysis Report (PIAR): This is an existing FAA analytical, diagnostic report and an integral part of Phase 5 of a PBN project. It could also become a recurring report containing continuously updated data using PDARS. *The PBN Blueprint Task Group recommends the existing PIAR format should be updated from the Master PBN Implementation Metrics Spreadsheet to identify the PBN metrics to be considered for each location. Based on the complexity of the procedures, this should occur after a time period sufficient for a normalization of the use of the procedures recognizing there is a "burn-in period," and seasonal changes (temperatures, winds, etc.).* The PBN Blueprint Task Group considers the current four month period provided in the FAA PBN Order may not be sufficient time to prepare the report and recommends the PIAR due date is set based on a specific burn in period for each PBN implementation considering its individual complexity, outcomes and metrics and other criteria.



6. Reports, findings, and lessons learned for the BPISs and PIAR should be kept in a secure repository and accessible at different levels. This will protect the sensitivity of the contributors and ensure the messaging is adapted for the audience. The BPISs may be kept in a local repository for phase implementation monitoring. They should be secure within the working structure of the local PBN WG. Stewards of the data and local PBN WGs should be comparing, analyzing, and refining data, metrics, indicators, and key performance areas, to ensure a nationwide incremental improvement of PBN.
7. The PBN Blueprint Task Group determined the need for the FAA to either be or select a data management and analysis center. Responsibilities would include but not be limited to: Collecting, filtering, analyzing, storing, de-identification of data as deemed appropriate, as well as disseminating data and analysis results. The end result could be that all data, reports, outcomes and lessons learned, would end up within a single data steward and lessons learned repository. The source of the data will vary between different PBN implementations, so there is also a need for a defined process structuring and governing data collection, as well as, its transfer to a data analysis center.

   Note: It is implied that the data management and analysis center could outsource data analysis and other activities as appropriate, but would manage and be held responsible for all data management activities.
   Note: The intent of this report is that management, storage and continual tracking of lessons learned highlighted within the Capturing Lessons – Future Effort should be aligned with Outcomes and Metrics for Success recommendations and vice versa.

8. As with the Capturing Lessons – Future Efforts recommendation, a task group or action team, should be established that includes the appropriate stakeholders to collaboratively develop outcomes and metrics, methods, sources, analysis and de-identification of data and a suitable data repository overseen by a data steward, building on the recommendations and appendices of this report.

   At the same time the task group or action team, should explore accessibility for both internal and external stakeholders and messaging of data to the general public. While firewalls and de-identification of data is essential to protect stakeholders, an easy method for approved users to access data is essential.

Existing Process & Lessons Learned

As PBN expands throughout the system, there is a continued case for providing a tool or mechanism that will deliver the desired results. Broader stakeholder interest in making use of Lessons Learned has grown, as more and more PBN procedures are implemented throughout the NAS. This interest is derived largely from the Air Traffic Control community that is responsible for developing new procedures as well as refining established procedures. Additionally, the Operator's community shares an interest in seeking to acquire an understanding of lessons learned that will foster greater utilization of PBN procedures. The Non-technical stakeholders can also find value in acquiring information pertaining to lessons learned associated with achieving community awareness and acceptance of PBN.

The current Metroplex initiatives are using the Project Tracking Tool as their current collection mechanism. The PTT is hosted in IBM Clear Quest at MITRE. The existing PTT is in a prototype form. However, its current limitations prevent it from providing the desired results expected as a Lessons Learned tool. It is difficult to integrate it with other systems and has limited viewing capabilities. It's capable of capturing significant amounts of data, but is difficult to retrieve and aggregate the data through Clear Quest. Navigating through the system is also a challenge for individual users.

The PTT is currently undergoing new development that will provide a more permanent solution. It will be hosted by the FAA using IBM Business Process Manager (BPM). It will deploy several significant features, which include:

- User friendly interface
- Integration with other systems, such as Aero Nav products
- Connection to external databases – NFDC, airport information, etc.
- Avoids human error since data exchanges electronically
- Aligns with 7100.41
- Captures important project information
- Automatic E-mail notifications and meeting invitations

Essentially, every aspect of a PBN project, from start through post implementation will be captured by the PTT. Data collection, processing and managing lessons learned is also a targeted function of the new platform.

The Blueprint Task Group applauds the efforts of the FAA and MITRE for the continued efforts in developing such a vital tool.

Findings Based on Existing Process and Lessons Learned

- Educational Pre-Kickoff meetings, including the core work group, must be accomplished in order to socialize the goals of PBN procedures and set proper expectations.
- The FAA must continuously strive to cast a compelling non-threatening vision for NextGen Concepts that dispels the vocational concerns of Air Traffic Controllers. Too often we hear from Controllers that they think PBN will result in a diminution of the workforce. In fact PBN and other NextGen concepts should be seen as catalysts for further specialization of the workforce, an evolution of the ATC functions and a viable way to increase the efficiencies of facilities.
- A formal change management process needs to be put in place and adhered to by all agencies that publish and release documents related to PBN IFP design and implementation activities. These documents include, but are not limited to, Memos, Notices, Advisory Circulars, and Orders. The process needs to allow for notification and distribution to all stakeholders in a timeframe that allows impacted parties a reasonable amount of time to respond to proposed changes or accommodate approved changes. In addition, it should allow for work in progress to be completed and implemented under existing criteria, processes and rule sets to the maximum extent possible, unless safety concerns dictate immediate suspension of all current and previous work and procedures.
- The Metroplex Study Team approach to developing notional designs is important to begin the process of promoting and visualizing what can be possible in terms of efficiencies for Controllers and other stakeholders. Notional concepts should be applied for all PBN initiatives.
- Scheduling practices should allow for significant advance notice to ensure that critical participants can support with continuity.
- It is not uncommon for an uncoordinated change to be made to a procedure that can have unintended consequences and negatively impact the flyability of the procedure. These modifications tend to occur after “pencils down” and are generally tied to a lack of proper coordination between the work group and how the procedure progresses through the pipeline of processing. It is vital to have a process that allows for consensus on procedures before the project can be considered “pencils down.” Once the procedures are “pencils down” procedures should not be modified in any way without workgroup consensus.
- Modeling and design tools currently do not provide the fidelity and robustness as full motion simulators, or live flights. With more complex procedures, it becomes even more important to conduct simulator analysis to validate procedures prior to publication. While not 100% fail safe, properly conducted simulator analysis can dramatically increase the chances of successful implementations.
- The sophisticated flight decks of many business aviation aircraft permit a wide variety of general aviation aircraft that can benefit from PBN. Along with the wide array of different airframes comes a multitude of flight management computers that have varied capabilities. This adds to the challenge of validating procedures that can be used by most aircraft.
- Flight simulation is not a requirement for PBN, but most major air carriers believe it is the only way to accurately validate procedures. The greatest challenge to this philosophy is the limited

availability to flight simulators, due to training needs of the airlines. Most business aviation operators do not have access to in-house flight simulators, as do most airlines for procedure modeling and validation. “Desk Top” simulators have also been used as a resource, but are primarily used for systems familiarity and training and lack the fidelity necessary to simulate the actual aircraft performance in PBN validations. However, the FAA is currently tasking researches to develop simulation tools that take a mathematical approach to simulating aircraft performance and fly ability of procedures, without the need for full motion simulators. This would not preclude full motion simulator testing, but would become the primary standard to check a wide variety of aircraft and FMS logic.

- It’s important to note the PARC VNAV Action Team has created guidelines and best practices for developing optimized profiles that may help reduce the need for extensive validation if a procedure is developed within the guidelines. Currently, this document is specific to the development of Optimized Profile Descents (OPD).
- When resources are available, the Lead Operator should evaluate the procedures in a simulator and considerations should include a broad range of aircraft types.
    - Reliance on individual operators to validate “flyability” of procedures across a vast fleet mix can be very time intensive and challenging for the lead operator, depending on the lead operator’s capabilities. In that regard, standard design criteria should be able to include the majority of operators at the selected location. Concepts of Operations (CONOPS) associated with capabilities and different levels of equipage must be resolved prior to acceptance of the PBN design(s).
    - Until such time cost effective and accurate modeling tools can be utilized, the following simulation guidelines should be used when simulators are available: Conduct simulations to assess flyability, flight crew human factors, and operational issues before a procedure is submitted to AeroNav Products for review utilizing the Flight Simulator Worksheet.

- There must be communication between the work group that is facilitated and assertively lead by a FAA lead.
- Aero Nav Products and Flight Standards should consistently participate in the process to better facilitate issues that arise and support a criteria based approach to procedure design. Single party disqualification of procedures that meet objectives and comply with criteria should be challenged. The “safety flag” is important but the SRM process should be used to qualify matters of safety.
- As PBN procedures are deployed across the NAS, when necessary, criteria must evolve with it. Whether it is existing criteria or a new project that requires a waiver, the integrity of an existing process must be maintained to ensure that safety is not compromised.

  The process of a criteria change often involves more than simply updating current FAA orders. Prior to going into effect, it may trigger numerous software and process changes internally within the FAA, as well as simulation and validation activities. If criteria changes and/or waivers are considered a requisite for a PBN implementation, this will most likely increase the project implementation timeline. Early coordination with Flight Standards may reduce the resulting impact. The PBN workgroup will have to evaluate each instance and determine whether the added timeline is an acceptable tradeoff between schedule and the waiver’s purpose. While not considered the norm, waivers remain a viable tool that can provide real world operational data in order to further justify a policy and/or rule revision that can then be transportable across the NAS.

- The FAA Lead needs to serve as the point of contact between the workgroup and Aero Nav Products.
- Once the Aero Nav Product Specialist completes their work the workgroup should have access to review the design prior to Quality Assurance checks.
- Controller training related to PBN prior to and after the implementation phase has been limited and inconsistent. The FAA needs to develop and better support training for ATC pre and post implementation.
- The Metroplex Process reserves Production Slots to facilitate changes to procedures if critical issues are found. This same process should be applied as a systemic rule.
- PBN implementations are not always perfect out of the box. Complicated airspace changes can contribute to these challenges. A period of normalization should be agreed to for post implementation. A three to six-month period should be allowed to pass before making anything other than safety related changes to procedures.
- Efficiency evaluations should be supported through extensive analytics using metrics that are supported/vetted by the stakeholders. Premature evaluations can be misleading. There are good reasons to consider a full seasonal cycle of data collection.

Recommendation for Capturing Lessons and Future Efforts

1. The PBN Blueprint Task Group recommends the FAA provide transparency and work closely with stakeholders to develop the key components of the Lessons Learned functions of the PTT. The PTT will require a clear vision of the needs, roles, and responsibilities from the users of the system, as well as the operators. While there have been some facilitators used to demonstrate the tool and collect feedback, it is not clear how detailed this has been.
2. A task group or action team should be established to include the appropriate stakeholders to collaboratively develop the requirements for the Lessons Learned aspects of the PTT. This should also include the opportunity to provide feedback on how stakeholders interface with the system in order to input, search, and apply the information. Interface will need to be less complicated and user-friendly and developed to address a variety of needs. Given the broader interests of both non-technical and technical stakeholders, an expanded data entry, analysis and querying capability will need to be established.
3. Identification of an automated communication chain that will require the development of a flow chart hierarchy to determine communication flow, e.g., AFS, ATC Facilities, PARC, A4A, NBAA, AOPA, etc. The communications also will require a categorization of issues that can foster effective and immediate dissemination of an issue. A process similar to the UAS Certificate of Authorization (COA) application process might prove useful in guiding the development of such a capability so as to leverage a similar intuitiveness for assigning actions.
4. In order for the Lessons Learned platform of the PTT to be successful, it is recognized that dedicated management and oversight by the FAA will be required in order to ensure that the expanded objectives of the aviation community can be achieved. As part of this oversight and as a recommendation, databases will need to receive periodic updates on solutions underway and notification of when an issue has been resolved by the organization(s) responsible for taking action to address issues. This will alleviate hurdles in data collection centered on processing, managing, and following through on actionable items.

5. As an upcoming key component in successful PBN implementations, the FAA PTT should receive an appropriate level of management, support and resources with regular review for ongoing improvement, in order for it to remain a viable tool.
6. To address the need to find better tools and methods for testing and validating flight procedures, the FAA should place a high priority on identifying the necessary resources and tools that can reduce the complexities of simulation and validation and thereby reduce the need for full motion flight simulations.

Checklist

This checklist is intended to support/complement FAA Order 7100.41 which provides a standardized five-phase implementation process that governs the FAA-led development and implementation of Performance-Based Navigation (PBN) routes and procedures. Furthermore, while FAA Order 7100.41 directs FAA Staff activities, this checklist is intended to provide guidance/direction to the broader stakeholder community that engages with FAA staff in PBN efforts to ensure all stakeholders are properly informed and engaged throughout the PBN process.

The check list is comprehensive and like FAA Order 7100.41 supports efforts ranging in scale from a single route or procedure to larger scale projects that integrate multiple procedures and/or routes. Additionally, it is not intended to supersede FAA Order 7100.41 nor other FAA orders and directives related to procedure development or implementation. Rather, it is intended to inform and guide all stakeholders to ensure they are enabled to effectively support and engage with the FAA in all phases of the overall process.

The PBN WG, in particular, will use this checklist to first ensure that all potential PBN stakeholders are properly informed of and are enabled to effectively engage in the PBN effort. The checklist then provides the PBNWG a high-level holistic review of the major activities that should be considered during each phase of the PBN process, and identifies the detailed checklists, FAA orders, and other relevant documents used by the PBN stakeholder community to ensure the development of consistent, efficient and effective PBN routes and procedures.

Recommendations:

- It is the recommendation of the PBN Blueprint Task Group that this more holistic checklist be incorporated into FAA Order 7100.41.
    - This will enable the checklist to be updated and refined as the PBN process itself is continuously refined through the capturing and dissemination of lessons learned from successive PBN development and implementation efforts.
- It is recommended that there be developed a best practice as to how to develop a Community Outreach Plan based upon local circumstances as well as the scope and scale of the particular PBN effort.
    - This is necessary in order to provide guidance and direction to all stakeholders as they take into consideration local community interests as well as the objective of

and intended PBN implementation so as to enable understanding and support of PBN deployment in support of all stakeholder interests.

Phase 1: PRELIMINARY ACTIVITIES

Prior to Initial Coordination: Responsible Party: AJV-14

Task: Develop preliminary project mission statement (i.e., overall goal, scope and scale of the proposed PBN effort)

Task: Ensure all potential Core Work Group (CWG) stakeholders, technical and non-technical, are notified of the proposed PBN effort, to include:

- proposed purpose/scope/scale of the PBN effort
- date/time/location of CWG Initial Coordination Meeting/Telecom

Task: Confirm intent of all potential CWG stakeholders to participate in the proposed PBN effort (note: stakeholders not electing to participate agree to accept/use the procedures/routes developed by the PBNWG)

Task: Identify organization that will be assigned responsibility for the data management support of the PBN effort (i.e., data collection, storage, analysis, report dissemination, etc.)

- It is recognized that the Post Implementation Analysis Report (PIAR), and By Phase Implementation Summary (BPIS) are all considered to be internal (FAA and Industry) reports
- As such, high-level extracts from information contained in some or all of these reports or other data streams will need to be collected and used in developing external reports that can be distributed to the affected community and for posting on the FAA NextGen website for broad outreach so as to confirm the outcomes of the PBN effort.
- Therefore, the data management plan must include the development and dissemination of a Community Outreach Post Implementation Benefits Report

Task: Disseminate the most recent versions of (or links to) all orders, checklists and other reference documents that will be used by the PBNWG throughout the PBN process.

Task: Offer enrollment opportunity as well as orientation/training to potential CWG members for accessing/using the Project Tracking Tool, Metroplex PBN Procedure Development and Implementation Checklist, and Microsoft Project Lessons Learned Database

- This serves as the commencement of both Technical and Non-technical Stakeholder Outreach efforts (two independent efforts) to enable working

group members to effectively engage in the PBN development and implementation effort

Initial Coordination - Responsible Party: AJV-14

Task: Identify any gaps in necessary stakeholder representation (both technical and non-technical) on the CWG, and take action to ensure appropriate stakeholder representation

Task: Gain commitment of all CWG members to fulfill their obligations as a CWG member so as to ensure efficient and effective execution of this phase of the PBN process

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

- Of particular note is the review and establishment of the overall goal (mission statement) of the PBN effort by the CWG

Conduct Baseline Analysis - Responsible Party: CWG

Task: Identify and review:

- Existing MOAs, MOU with adjacent sectors and DOD SUA
- Existing Environmental Agreements, as well as local community concerns that might affect or be affected by the intended scope and scale of the PBN effort

Task: Identify and document expected high-level outcomes and metrics for the project

- Determine the anticipated high-level outcomes and metrics that will be used to measure and report on the success of the specific effort
- Determine what metrics will be used to measure the contribution that the effort will make to the overall national goals

Task: Identify and document data management plan for the project

- Formulate preliminary data management plan and determine resource requirements and challenges to implement
- Commence collection of baseline data, prior to PBN implementation (is essential in order to enable measurement of benefits, as well as to confirm integrity of and effectiveness of data collection plan)

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Task: Develop scope/scale of the anticipated environmental review and Community Outreach Effort encompassing education, engagement and advocacy as deemed appropriate for the intended PBN effort

Task: Develop scope/scale of the anticipated Technical Stakeholder Outreach Effort encompassing education, and training as deemed appropriate for the intended PBN effort

Task: Confirm that all CWG members and their organizations understand their obligations and are committed to properly resource the proposed PBN project so as to ensure the efficient and effective execution of the remaining phases of the intended PBN effort

Submit PBN Project for Approval and Publication Date – CWG

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Phase 2: DEVELOPMENT WORK

Prior to Establishing the PBN Work Group (PBN WG) -
Responsible Party: Project Facilitator (PF)

Task: Ensure all potential PBNWG stakeholders, both technical and non-technical, are notified of the proposed PBN effort, to include:

- The approved PBN Project Mission Statement, goals, as well as the scope/scale of the PBN effort
- The anticipated level of environmental review and Community Outreach Effort encompassing education, engagement, and advocacy
- The anticipated level of Technical Stakeholder Outreach Effort encompassing education as well as training
- Date/time/location of Full WG Initial Coordination Meeting/Telecom

Task: Confirm intent of all potential PBNWG stakeholders to participate in the PBN development effort (note: stakeholders not electing to participate agree to accept/use the procedures/routes developed by the PBNWG

Task: Disseminate the most recent versions of (or links to) all orders, checklists and other reference documents that will be used by the PBNWG throughout the PBN process

Task: Offer enrollment opportunity as well as orientation/training to potential PBNWG members for accessing/using the Project Tracking Tool, Metroplex PBN Procedure Development and Implementation Checklist, and Microsoft Project Lessons Learned Database

Establish PBN Work Group – Responsible Party: PF

Task: Identify any gaps in necessary stakeholder representation on the PBN WG, and take appropriate actions to ensure appropriate stakeholder representation

Task: Obtain commitment of all PBNWG members to fulfill their obligations as a PBNWG member so as to ensure efficient and effective execution of this phase of the PBN process

Task: Conduct Technical Stakeholder Outreach Effort encompassing education, and training as deemed appropriate for the intended PBN effort

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Work Group Meetings – Responsible Party: PF

Task: Initial Meeting

- obtain understanding/concurrence with the overall objective of the PBN effort
- obtain understanding/concurrence with the approach to environmental review as well as community outreach based upon latest best practice to approaching community outreach
- ensure all PBNWG members are familiar with PBN process, and if not, offer orientation/training to ensure all members can effectively fulfill their duties as part of the PBNWG
- obtain commitment of all PBNWG members to fulfill their obligations as a PBNWG member so as to ensure efficient and effective execution of this phase of the PBN process

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Design of PBN Procedures and Routes - Responsible Party: PBNWG

Task: Review and adhere to the latest version of the Metroplex PBN Development and Implementation Checklist and modify (tailor) as deemed appropriate for proposed PBN effort to ensure consistent, efficient, and effective procedure/route development

Task: Identify how proposed procedure(s) and route(s) affect, and can be properly supported by adjacent sectors, as well as DOD SUA as may be applicable

Task: Review status of environmental review as well as ensure completion of the Community Outreach Plan and its appropriateness to support the implementation of the proposed PBN procedures and routes

Task: Review and approve data collection and analysis plan, as well as the proposed:

- Post Implementation Analysis Report (FAA order 7100.41), and

- Community Outreach Post Implementation Benefits Report (new)
  - Containing high level metric reporting for informing local community of general PBN benefits

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

- of particular emphasis is the review and categorization of any requested waiver (i.e., two types: the first being a waiver intended to serve as a mechanism by which data will be collected with the anticipation that a new standard may be developed, or the second being a waiver considered to be required due to the local conditions)
- inform the PBNWG of the time and resources required to obtain as well as maintain a waiver to ensure all parties fully understand the impact that requesting a waiver will have on the PBN effort

Procedure and Route Evaluation and Approval - Responsible Party: PBNWG

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

- PBNWG members should:
  - reaffirm and commit to the PBN effort milestones and resource requirements implied by the proposed procedure(s) and route(s)
  - confirm that the proposed procedure(s) and route(s) will achieve the overall goal (mission statement) of the effort
  - confirm that the data management plan will adequately support the proposed effort

Phase 3: OPERATIONAL PREPARATION

Responsible Party: PBNWG

Task: Ensure conformity with the Modified/Tailored Metroplex PBN Procedure Development and Implementation checklist items associated with this phase of the development effort

Task: Review status of environmental review as well as completion of those Community Outreach activities to be conducted in advance of PBN procedure/route implementation

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Procedure and Route Processing –
Responsible Party: ATO Service Center Operations Support Group

Task: Ensure that all necessary airspace actions are identified and taken with affected adjacent sectors, as well as DOD SUA as may be applicable

Notification and Training – Responsible Party: Air Traffic Facility

Task: Ensure that effective communication, collaboration and coordination as well as training of all appropriate personnel has taken place with those personnel responsible for air traffic management of affected adjacent sectors, as well as DOD SUA as may be applicable

Automation

Implementation Planning – Responsible Party: PBNWG

Task: Conduct review current status and required activities associated with environmental review as well as the Community Outreach and include this information in determining a date to implement the new procedures/routes

Phase 4: IMPLEMENTATION

Responsible Party: PBNWG

Task: Review and adhere to the Modified/Tailored Metroplex PBN Development and Implementation Checklist for all tasks associated with this phase of the PBN process

Task: Review and adhere to the activities specified in the Community Outreach associated with this phase of the PBN process

Task: Ensure data acquisition and associated analysis is effective and direct modifications to same if situation warrants

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Phase 5: POST IMPLEMENTATION MONITORING AND EVALUATION

Responsible Party: PBNWG

Task: Review and adhere to the Modified/Tailored Metroplex PBN Development and Implementation Checklist for all tasks associated with this phase of the PBN process

Task: Review and adhere to the activities specified in the Community Outreach associated with this phase of the PBN process

Task: Perform all tasks as identified in FAA Order 7100.41 that apply to this phase of the PBN process

Implementation Monitoring

Post Implementation Analysis – PBNWG (Data Management Authority)

Task: Review and adhere to the reporting activities specified in the Community Outreach associated with this phase of the PBN process, specifically:

- the development and dissemination of a Community Outreach Post Implementation Benefits Report
- the development and posting of Post Implementation Benefits contributing to the national goals on the FAA NextGen website

PROJECT COMPLETION.

Additional Recommendations

The following recommendations were not directly requested in the FAA's Tasking Letter to the NAC, but were identified by the Task Group.

Use of Temporary Special Procedures

Varying circumstances can make implementing PBN a challenge in some facilities and other portions of the national airspace. An effective tool has been the use of creating a "temporary special" procedure(s) that can be designed and implemented in much less time than a "public" procedure. This is accomplished with the assistance and resources of the AFS-400 group.

As an example, Charlotte Douglas Airport was "introduced" to an Optimized Profile Descent by working with the lead operator to develop a Special RNAV STAR under the guidance and support of AFS and coordinated with Air Traffic. It required the lead operator to bear the expense of tailored charting and a custom database. This allowed pre-coordinated validation flights and pre-specified times for operations on the procedure.

This type of development concept permitted the controllers from two ARTCCs and the TRACON to gain familiarity and comfort with the new operations without completely changing their overall operations. As operational experience was gained, recommended changes to the procedure were made to make it better for ATC and the operator. These changes could occur rapidly, as it did not require the normal pipeline process. Once the ATC facilities and the operator were satisfied with the operations and the procedure, it went through the normal public procedures process and was implemented for full-time operations by all users.

The Blueprint Task Group recommends the FAA establish a formal process to use this approach to procedures development when it is deemed necessary and beneficial. It could prove to be a very cost effective and time saving tool at many locations and PBN initiatives.

Appendix A: Members of the Blueprint for Success to Implementing PBN Task Group

Hal Andersen	GE Aviation
Chris Baum	Air Line Pilots Association
Joe Bertapelle	JetBlue Airways
Tom Bock	Port Authority of New York & New Jersey
Mark Bradley	Delta Air Lines, Inc.
Michael Caflisch	The Boeing Company
Andy Cebula	RTCA, Inc.
Mack Coker	U.S. Air Force
Lynae Craig	Alaska Airlines
Donna Creasap	Federal Aviation Administration
Jim Crites	**Dallas/Fort Worth International Airport (Co-Chair)**
Rick Dalton	Southwest Airlines
William Dunlay	LeighFisher
Ken Elliott	Jetcraft Avionics LLC
William Fernandez	Professional Aviation Safety Specialists
Rob Goldman	Delta Air Lines, Inc.
Daniel Hanlon	Raytheon Systems Company
Tom Kramer	Aircraft Owners and Pilots Association
Trin Mitra	RTCA, Inc.
Bill Murphy	International Air Transport Association
Juan Narvid	DoD Policy Board on Federal Aviation
Chris Oswald/ Katherine Preston	Airports Council International – North America
Colin Rice	Houston Airport System
Dennis Roberts	Federal Aviation Administration
Mike Sammartino	Metron Aviation, Inc.
Phil Santos	FedEx Express
Jason Schwartz	Port of Portland
Rico Short	Beacon Management Group
Stephen Smith	ATAC
Stephen Smothers	Cessna Aircraft Company
Mark Steinbicker	Federal Aviation Administration
Greg Tennille	The MITRE Corporation
Brian Townsend	**American Airlines (Co-Chair)**
Emily Tranter	NOISE
Allan Twigg	United Airlines, Inc.
Steve Vail	Mosaic ATM, Inc.
Jeff Woods	National Air Traffic Controllers Association

Appendix B: Index PBN Reference Material

Name	Source	Date
Approaches to Integrating Airport Development and Federal Environmental Review Processes	Airport Cooperative Research Program, Synthesis 17	2009
Aircraft Noise: A Toolkit for Managing Community Expectations	Airport Cooperative Research Program, Report 15	2009
Recommendation for Key City Pairs for Measuring NextGen Performance	A Report of the NextGen Advisory Committee in Response to Tasking from The FAA	February, 2013
Fair Skies Link: http://mspfairskies.com/ Video PPT presentation	Community Group related to MSP PBN Implementation	February 2013
Integrating Planning and NEPA Processes for Airport Development Projects	Airports Council International – North America	May, 2013
Airports' Role in the Development and Implementation of Performance Based Navigation (PBN) Flight Procedures	Airports Council International-North America, NextGen Working Group	March, 2013
Recommendation for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS)	A Report of the NextGen Advisory Committee in Response to Tasking from The Federal Aviation Administration	June, 2013
Recommendation for Prioritization of PBN Procedures	A Report of the NextGen Advisory Committee in Response to Tasking from The FAA	September, 2013
NextGen—Guidance for Engaging Airport Stakeholders	Transportation Research Board	February, 2014

Name	Source	Date
Addendum to Recommendations for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS) – Industry Barriers	A Report of the NextGen Advisory Committee in Response to Tasking from The FAA	February, 2014
NAC Inputs for PBN Blueprint Task Group	Excerpted from NAC Meeting Summary related to Outcomes and Metrics for Success	February, 2014
FAA JO 7110.65U Air Traffic Organization Policy	This order describes air traffic control procedures and phraseology for use by personnel providing air traffic control services	April 3, 2014
FAA JO 7100.41 Performance Based Navigation Implementation Process Implementation Process	This is an ATO document, issued April 3, 2014 which describes the 5-phase implementation process related to PBN routes and procedures.	April 3, 2014
FAA Order 8260.43B, AFS-400	This order describes how to request the development, amendment, or cancelation of an Instrument Flight Procedure (IFP) and defines FAA process for coordinating, approving, and prioritizing each request.	April 22, 2013
OAPM Ops Plan	Schedule plan from FAA regarding selected OAPM sites	

Appendix C: Metrics Reference Material

PBN Post-Implementation Analysis Report

PDX (Portland, OR) RNAV STARS/RNP

August 2014

Introduction

The Portland, OR (PDX) PBN initiative began from an update to the Port of Portland's FAR Part 150 Noise Compatibility Program (NCP). The Port initially installed the PDX VOR as part of a NCP to improve departure track compliance over the river. An update to the NCP included recommendations to use satellite-based navigation to improve track adherence to the preferred noise abatement tracks. This lead to decommissioning the PDX VOR, resulting in the need for development of a new arrival procedure from the east. The scope expanded into a PBN project that included three new RNAV STARS and RNP approaches to each runway end. The PBN initiative was a collaborative effort between FAA, Port of Portland, and air carriers with Alaska Airlines serving as the lead operator.

The mission and scope of this RNAV Benefits Assessment includes assessing the realized and potential benefits of PBN implementation in a number of key areas.

Goal/KPAs: Reduce reliance on ground-based NAVAIDS to improve noise abatement flight track adherence.

Objectives/Sub-KPAs: *(PBN Order Phase 1)*

- Replace the conventional BONVL STAR with an RNAV STAR
- Overly the conventional HELNS and MOXEE STARS with new RNAV STARS
- Improve environment by providing optimized profile descents for reduced fuel burn
- Develop RNAV(RNP) instrument approach procedures for track mile savings, reduce unstabilized approaches from the east, and reduce low altitude vectoring
- Improve efficiency of airspace and arrival routes given terrain considerations
- Meet or exceed safety requirements
- Improve environment by reducing emissions and noise exposure for area communities

Work Group Key Stakeholders/Roles *(PBN Order Phase 2)*

- Port of Portland – Community engagement, government relations, local expertise (operational, community, environmental, etc.).
- Alaska Airlines/Horizon Air - Lead Operator, sim evaluations, training
- FAA ATCT/TRACON/ZSE - Local airspace expertise, Facility LOAs, briefings, training
- FAA NATCA - Traffic handling expertise (published vs. flown)
- ATO Operations Support Group - Project management, environmental analysis

Procedures Developed/Implemented *(PBN Order Phase 2 and 4)*

- March 2013 – HHOOD RNAV STAR (replaced BONVL STAR due to VOR decommissioning)
- October 2013 – KRATR RNAV STAR (overlay of the conventional HELNS) and RNP approaches to Runways10L-28R and 10R-28L
- February 2014- Identified need to update RNAV (RNP) Y Rwy 28R/L
- April 2014 – TMBRS RNAV STAR (overlay of the conventional MOXEE)
- January 2015 – Updates to all three RNAV STARS and the RNAV (RNP) Y Rwy 28R/L

Key Performance Areas (KPAs) *(PBN Order Phase 1)*

- Reduced reliance on ground-based NAVAIDS
- Reduced Fuel Burn
- Efficiency
- Safety
- Productivity
- Environment

Key Performance Indicators (KPIs) *(PBN Order Phase 1)*

1) Replace or augment conventional STARS with RNAV STARS
   Metric: Number of RNAV STARS replacing conventional arrivals
   Metric: NAVAID Decommissioning (VOR)

2) Reduced Fuel Burn – Descent profile, reduced emissions, reduced track miles, reduced low altitude vectoring, reduced flight time
   Metric: Track miles from TOD to 5000' on each STAR
   Metric: Fuel burn on descent from TOD to 5000' (conventional vs. RNAV replacements)
   Metric: Compare profile of low altitude vectors to ILS vs. RNP approaches (vertical and track miles)
   Metric: Number of flights using each procedure

3) Airspace Efficiency – Reduction in flight time (compared to conventional arrivals/approaches using legacy NAVAIDS and ATC vectoring).
   Metric: Flight time from TOD to waypoint at 5000' on each RNAV STAR vs. Conventional (or TOD to touchdown)
   Metric: Flight time from start of RNP to touch down vs. Conventional
   Metric: Arrival Rate/Departure Rate
   Metric: Traffic Management Initiatives (ex. miles in trail less than or greater? /what is tradeoff?)-

4) Safety – Unstabilized approaches from the East, reduced hear back/read back errors/pilot workload
   Metric: Number of go-arounds due to unstabilized approaches pre/post implementation
   Metric: Number of radio transmissions pre/post implementation (reduction of at least 7)
   Metric: Fewer pilot actions – altitude, mode, heading changes

5) Productivity – Reduced controller workload due to reduced low altitude vectoring
   Metric: Number of flights using RNP approach vs. vector to ILS Pre/post Implementation

6) Environment – Reduced emissions, reduced population exposed to overflights, concentrated flight paths over more compatible land uses, RNP approach path at higher altitude than vectors, ground tracks same as conventional procedures, reduced noise for single events on OPD.
   Metric: Population exposed to overflights pre/post implementation
   Metric: Reduced fuel burn/reduced emissions
   Metric: altitude of approach path of RNP at specific points over populated areas (higher than with vectors to ILS)
   Metric: Number of newly exposed population (zero)
   Metric: Improved track precision/predictability of arrivals and approaches over compatible land uses. (Versus conventional arrivals/approaches or vectoring)
   Metric: Number of Events Above a specified noise level (NAx) pre-and-post PBN implementation based on grid-point analysis.
   Metric: Number of Overflights pre-and-post PBN implementation based on grid-point analysis.

Data Required for Analysis *(PBN Order Phase 5)*

- Radar/lateral and vertical flight paths
- Airline FOQA
- Land Use/Population
- Procedure utilization counts
- Go-Around records
- Noise monitoring

Issues, Trade-Offs, and Actions *(PBN Order Phase 5)*

- Lack of clarity of who is responsible for overseeing the post-implementation analysis report. Unavailability of data sources (specifically FAA radar flight track data).
- *Action:* Need commitment from FAA to lead post-implementation analysis and/or provide access to radar data and procedure utilization data for 3rd party to conduct analysis
- Pilots don't request the RNP and typically don't accept it if it's offered by ATC
  Action: use ATIS to provide expectation of RNP and brief pilots to encourage acceptance
- RNP Rwy 28 connectivity to HHOOD required modifications

Action: procedures were modified. Pub date scheduled for Jan 2015

- Use of RNP approaches reduces airport capacity due to higher separation requirements.
  Action: When demand nears capacity, ATC stops using RNP and reverts to ILS.
  Action – Long Term: "Established on RNP" rule change will benefit PDX.
- ATC needs better predictability of when transition to 280 kts will take place
- Challenges to sequence DH-400 with turbojets – speeds/terrain clearance

Lessons Learned *(PBN Order Phase 5)*

- Working closely with the Port Authority in the initial design phase kept airline/FAA goals in line with airport's sustainability goals.
- Collaboration with the community enabled community interests and concerns to be addressed during planning and design resulting in minimal public opposition/controversy

Results (*PBN Order Phase 5)*

(Following data analysis, present summary of results tied to objectives)

Appendix D: Department of Defense Airspace Contacts

National DoD liaisons to FAA

USAF and Senior Mil Rep to HQ FAA
Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591
Phone: (202) 267-9427

US Marine Corps Rep to HQ FAA
Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591
Phone: 202-267-8439

US Navy Rep to HQ FAA
Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591
Phone: (202) 267-9431

US Army Rep to HQ FAA
Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591
Phone: (202) 267-9429

Eastern Service Area

Air Force Rep to FAA (AFREP), Eastern Service Area
1701 Columbia Ave,
College Park, GA, 30337
Phone: (404) 305-6901

Marine Corps Rep to FAA, Eastern Service Area
1701 Columbia Avenue
College Park, GA 30337
Phone: (404) 305-6907

Navy Rep to FAA, Eastern Service Area
1701 Columbia Avenue
College Park, GA 30337
Phone: (404) 305-6908

Army Rep to FAA, Eastern Service Area
1701 Columbia Avenue
College Park, GA 30337
Phone: 404-305-6916

FAA Military Liaison Officer, Eastern Service Center
Phone: (404) 305-5611

Central Service Area

Air Force Rep to FAA (AFREP), Central Service Area

AFREP ASW 910

2601 Meacham Blvd

Fort Worth, TX 76193

Phone #: 817-222-5911

Navy Rep to FAA, Central Service Area

2601 Meacham Blvd

Fort Worth, TX 76193

Phone #: 817-222-5931

Army Rep to FAA, Central Service Area

2601 Meacham Blvd

Fort Worth, TX 76193

Phone #: 817-222-5921

Western Service Area

Western Service Area-

Air Force Rep to FAA (AFREP), Western Service Area

Address: 1601 Lind Ave Sw, Renton WA, 98507

Phone: 425-227-2947

Marine Corps Rep to FAA, Western Service Area

Address: 1601 Lind Ave Sw, Renton WA, 98507

Phone: 425-227-1384

Navy Rep to FAA, Western Service Area

Address: 1601 Lind Ave Sw, Renton WA, 98507

Phone: 425-227-2740

Army Rep to FAA, Western Service Area

Address: 1601 Lind Ave Sw, Renton WA, 98507

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Appendix E: Master PBN Implementation Metrics Spreadsheet

Goals (national) *Defined by all or sets of PBN implementations*	KPA (BCPMWG) for NextGen *NAS wide. Outcome metrics. National system objectives*	KPA (for PBN) or major checklist item *For a PBN*	KPA or major checklist item mapped to PBN Order *There are 5 phases. Items apply differently to each*	Sub KPA/Checklist *add each to corresponding line in previous column*	PBN Objective *A KPA expanded for a specific PBN*	Metrics KPI 1	Metrics KPI 2	Metrics KPI 3	Metrics KPI 4	Metrics KPI 5	Metrics KPI 6	Metrics KPI 7	Metrics KPI 8	Metrics KPI 9	Metrics KPI 10
Goals		Goals	Goals defined and tracked	Short term											
				Long term											
	Cost effectiveness	Approvals	Implementation approval	Economic	TBD	Benefit v cost	Reduced infra	Reduced benefit from less infrastructure							
	ATC cost efficiency			Environmental		Cat Ex	EA/FONSI	EIS/ROD							
	ATC cost/IFR flight hour			Timeliness											
		Capability	Capability	Ground ops		ATC equip	ATC train	Proc in place	Proc approved						
				Air ops		A/C equip	A/C train	Operator appr							
		Participation	User group participation	Total # of users		% equipped	% not equipped		Number of flights						
				Acceptance over time		% pilot used	% control used								
				Aircraft type		ability to use									
				NAS user group		offer v request	Number of flights								
			Stakeholder participation	Involved		Level	Technical	Non-Technical							
				Not involved		ext circumstance									
				Lessons learned											
		Impacts	Community impacts	Local community		Buy in	Benefits								
				Local ATC		Buy in									
				Passenger		Benefit	Cost								
				Societal		Benefit	Cost								
	Safety	Safety	Safety	Flight path		Deviation track									
				Unstabilized approach		Number of uns	Reduction of radio transmissions								
				CAST - FAA only											
	Fuel efficiency	Environmental perf	Environmental perf	Fuel Use		Track miles fro	Fuel burn on d	Low altitude vectoring							
	Ton-miles per gallon			Noise		Reduced popu	Altitude of flig	Thrust setting changes below 5000 ft							
				Emmisions		Thrust setting changes below 5000 ft									
	Efficiency	Efficiency	Flight efficiency	Individual operators		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
	Operational effic.			Wider group op's		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
	Total trip time			ATC		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
	Mean trip time			Runway		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
				Airport		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
				Metroplex		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
				NAS		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
				TARGETS Modeling		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
				Legacy transition		Flight/block ti	Total track m fl	Fuel burn	Variability	Predict/Repea	Accuracy	Delays	% of use	Workload	
	Access	Access/Throughput	Airspace efficiency	Access		Runway	Airport	Metroplex	NAS	Operator	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
	Metroplex access			Throughput		Runway	Airport	Metroplex	NAS	Operator	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
	Air/Gnd separation alert rate			TARGETS Modeling		Runway	Airport	Metroplex	NAS	Operator	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
	Metroplex peak allowable throughput			*All inc WX impacts*		*Runway*	*Airport*	*Metroplex*	*NAS*	*Operator*	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
				All inc PT impacts		*Runway*	*Airport*	*Metroplex*	*NAS*	*Operator*	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
		Interoperability + Trade-off	Interoperability + Trade-off	Systematic		Terminal	Enroute	Other	Environmental						
	Capacity	*Capacity*	*Capacity*	*Capacity impacts*		Runway	Airport	Metroplex	NAS	Operator	*Wake turb*	*TBFM*	*NG tech*	*New runways*	
	Metroplex capacity														