Build Airport Capacity or Manage Flight Demand?

How Regional Planners Can Lead American Aviation Into a New Frontier of Demand Management

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Problem, research strategy, and findings: To address air traffic congestion, airports can manage flight demand or expand capacity; the Federal Aviation Administration (FAA) requires an environmental impact statement (EIS) to evaluate feasible alternatives to capacity expansion. The FAA also funds regional planning agencies to conduct optional regional aviation systems plans (RASPs). We study the extent to which airports investigate demand management in lieu of increasing capacity and if RASPs play a role in doing so. Of the 17 EISs for major airport capacity expansions between 2000 and 2013, only Boston (BOS), as influenced by the local RASP, fully assessed demand management. We find three barriers to airports evaluating demand management in their EISs: narrow project objectives, uncertainty over the FAA's stand on demand management, and economic development concerns. RASPs can help surmount these barriers because they are not constrained by the EIS's narrow objectives and can comprehensively evaluate demand management alternatives.

Takeaway for practice: Demand management in aviation, as in surface transportation, holds potential for cost and other savings. Strengthening the role of regional planners in the airport planning process would lead to greater consideration of demand management and may bring innovative solutions to airport congestion. We recommend: a) the FAA play a more direct role in funding regional aviation planning and creating regional aviation planning coalitions; b) regional planners collaborate early in the airport EIS process; and c) planners encourage the FAA to make demand management a mandatory alternative in an EIS for airport capacity expansion.

Keywords: Regional Aviation Systems Planning, demand management, airport capacity planning, National Environmental Policy Act

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Journal of the American Planning Association,
Vol. 80, No. 2, Spring 2014
DOI 10.1080/01944363.2014.961949
Published with license by Taylor & Francis

Airport demand management has significant potential to reduce aviation system delay, increase safety, and reduce environmental impact (e.g., Arnott & Stiglitz, 1989; Nero & Black, 1998; Swaroop, Zou, Ball, & Hansen, 2012). Demand management in aviation, as in other transportation modes, involves using pricing, incentives, or regulations to redistribute demand instead of solving congestion and capacity problems by increasing supply; that is, building new runways and even new airports. Yet some researchers contend that transportation demand management will hinder economic development (e.g., Brueckner, 2003; Tittle, McCarthy & Xiao, 2013). The tradeoff between safety, environmental impact, and economic development represents a classic tradeoff in infrastructure planning that cuts across transportation modes (e.g., Meyer, 1999). Without a comprehensive assessment of aviation demand management, we know little about the balance of tradeoffs between managing demand and increasing capacity. Freestone (2009) argues that urban planners must position themselves to fill this knowledge gap.

Regional aviation system planners have a long but inconsistent history of studying airport demand management (Bednarek, 2001). In 1973, Joseph Sax lauded a 1971 comprehensive study of congestion and demand management at New York's John F. Kennedy International Airport. However, he lamented

that the study "seemed not to have the slightest effect on the planning of airport officials, who quite uniformly go forward with recommendations for new runways…. I see no trace of it in the issues that are discussed in the [environmental impact] statements" (Sax, 1973, p. 245). To receive Federal Aviation Administration (FAA) funds for capacity expansion, airports must prepare an environmental impact statement (EIS); the FAA will also support regional planning agencies to conduct a regional aviation systems plan (RASP), although few take that opportunity, and it is not required for capacity expansion.

Sax highlighted the missed opportunity in the EIS to explore environmentally innovative solutions offered by demand management. Forty years later, regional planning agencies have the capacity to conduct a RASP, which is much more likely to seriously evaluate demand management options. We build on Sax's perspective, and the potential of a RASP, to assess how federal, regional, and local aviation organizations plan to address capacity problems, study the tradeoffs between demand management and increasing supply, and integrate their findings into airport EISs.

We investigate the extent to which airport EIS documents include a comprehensive analysis of demand management in the EISs for 17 airport runway expansion projects completed or planned at major U.S. airports since 2000. We find that a single airport—Boston Logan International Airport (BOS)—conducted a comprehensive analysis of demand management. Significantly, a RASP conducted by planners in the New England Airport Coalition played a role in ensuring that the airport did so. The RASP showed that regional economic development would flourish if flights were spread across the greater Boston region rather than focused at a single major airport.

We find three overarching barriers that airports contend constrained them from performing a comprehensive analysis of demand management: narrow project objectives, uncertainty over demand management policy, and economic development concerns. We consider how regional airport planners can help surmount these barriers by focusing their regional airport planning efforts on regional growth and integrating with the local airport capacity planning process. We recommend the creation of regional aviation planning coalitions and that the FAA play a more direct role in funding and advocating for regional aviation systems planning. In addition, we recommend that regional planners instigate early and integrated collaboration in airport EIS analysis. Finally, if numerous RASP efforts are successful in educating the FAA and airports about regional solutions to congestion, we recommend that the FAA make demand management a mandatory alternative in a capacity expansion EIS.

A Brief History of Airport Capacity, Congestion, and Demand Management

We briefly describe the history of aviation congestion and demand management to familiarize planners with relevant terminology and aviation planning processes. For a more detailed review, see Bailey, Graham, and Kaplan (1985) and de Neufville and Odoni (2013) for history, and Czerny, Forsyth, Gillen, and Niemeier (2008) and the U.S. Government Accountability Office (GAO; 2012) on demand management.

Airport Congestion on the Rise

Prior to the 1970s, the federal government regulated domestic airlines. Airline regulation served as a form of capacity management because a single entity assigned routes and flight frequencies to airlines. In the late 1970s, the federal government deregulated the airlines, allowing the airlines to schedule domestic flights at their own discretion (Bailey et al., 1985). Many of the stated benefits of deregulation—lower fares and increased service—were quickly realized, resulting in a surge in demand for air travel from the general public (GAO, 1996).

In the current deregulated airline environment, airlines hold the authority to set their schedules, including the routes served, the frequency in which they are served, and the aircraft used to serve each route. After deregulation, airlines largely expanded their network of flights by building on their established hubs, because launching a new hub incurs high fixed costs (Morrison, Winston, Bailey, & Kahn, 1989). At their hubs, airlines intensified their use of the hub-and-spoke model[1] to exploit economies of scale (Bailey et al., 1985). In seeking to increase profit, airlines found that increasing flight frequency was a more effective tool to garner market share than reducing fares (Borenstein & Netz, 1999; Wei & Hansen, 2005). In short, airlines found increasing the number of flights serving their key hub airports both minimized cost and maximized profit.

Delays result when the number of flights arriving at an airport approaches or exceeds the capacity of the airport to serve them. The FAA's air traffic controllers, who manage the safe routing of aircraft, delay aircraft on the ground at their origin when they anticipate congestion at the destination; aircraft queuing in the air occurs when there is an unexpected imbalance between capacity and demand, generally due to weather (Moses & Savage, 1990; Vossen, Hoffman, & Mukherjee, 2012). While the link is tenuous, congested

environments both in the air and on the ground may be correlated with minor safety faults, such as when the headway between landing aircraft is too short or when two aircraft are present on an active runway at the same time (Endsley & Rodgers, 1997; Majumdar & Ochieng, 2002; Moses & Savage, 1990; Wickens, Mavor, & McGee, 1997).

The responsibility for safety of the airspace falls on the FAA (FAA Authorization Act of 1994, 2011). Since a congested airspace can increase workload for the air traffic controllers responsible for aviation safety, FAA has a responsibility to work with an airport to take action if the airport experiences excessive delay (generally more than a 15-minute average delay over a period of time). There are two overarching mechanisms, as in all modes of transportation, through which the FAA, with the help of airports, can reduce delay: expanding the transportation infrastructure or managing transportation demand (Ferguson, 1990; Rutner, Mundy, & Whitaker, 1997).

Controlling Congestion With Demand Management

If current or future congestion levels are expected to exceed capacity such that air traffic controllers must routinely mitigate delay, the FAA and airport sponsor will seek to expand airport capacity or to manage demand. FAA policy promotes building. It is FAA policy that "projects that increase [airport] capacity…be undertaken to the maximum feasible extent so that safety and efficiency increase and delays decrease" (FAA Authorization Act of 1994, 2011). Alternatively, two demand management strategies are currently available: 1) caps on operations and 2) congestion pricing. Both are undertaken to ensure safety in the face of mounting congestion (Arnott & Stiglitz, 1989; Hansen & Zhang, 2005; Le, Donahue, & Chen, 2007).

The FAA has sole authority to cap the number of flights per hour at an airport (FAA Authorization Act of 1994, 2011), an action that prohibits airlines from scheduling flights in excess of the cap. The FAA has a history of imposing flight caps on airports with excessive congestion. In 1969, the FAA imposed a cap during certain hours at the congested airports of the New York metropolitan area, Chicago (O'Hare International in Illinois), and Washington, DC (National Airport in Arlington, Virginia; GAO, 2008). FAA policy, however, is not supportive of caps as a long-term capacity management solution. FAA policy explains that "artificial restrictions on airport capacity are not in the public interest and should be imposed to alleviate air traffic delays only after other reasonably available and less burdensome alternatives have been tried" (FAA Authorization Act of 1994, 2011). Consistent with this stated policy, the FAA discontinued caps at Chicago after the addition of a new O'Hare runway in 2008.

As an alternative to caps, the FAA permits airports to manage airline demand by charging congestion fees. All airports charge airlines a weight-based landing fee on a per-flight basis to generate revenue to cover airfield maintenance. FAA policy explicitly allows airports to modify the landing fee such that it is composed of two parts: one part representing the average cost of providing access and the second part representing a congestion charge for aircraft landing during periods of high demand (Policy Regarding Airport Rates and Charges, 2008). The goal of the congestion charge is to encourage airlines to offset the cost of the fee by shifting their flights from peak hours to off-peak hours, consolidating flights on aircraft with higher seat capacity, shifting traffic to regional airports, or eliminating flights altogether (de Neufville & Odoni, 2013).

The FAA imposes a limit, however, on the total revenue that can be collected from congestion charges; it does not permit airports to generate revenue beyond their costs to maintain and operate the airfield (Plavin, 2007). In addition, FAA policy states the measure should be imposed "only where airport development projects cannot be built…in time to prevent congestion" and identifies capacity enhancement as the preferred response to managing demand (Policy Regarding Airport Rates and Charges, 2008, p. 40439). Unlike airport flight caps, two-part landing fees are not currently in use at any U.S. airport.

Airport Planning and Development

The planning of airport capacity occurs at multiple levels of government in the United States and follows a complex process that can vary across regions and geographies. In this section, we summarize the role of the FAA, the airport sponsor, and regional planning agencies. We focus on details that are particularly important for demand management; for a broader discussion of airport capacity planning, we refer the reader to Coogan et al. (2010), GAO (2009), de Neufville and Odoni (2013), and Young and Wells (2011).

The Interdependent Process of Local and National Airport Planning

The FAA focuses on the national system[2] in planning airport capacity. The FAA provides substantial funding for planning activities and airport construction through the Airport Improvement Program (AIP), a formula-based program[3] authorized at more than $3 billion annually since 2001 (FAA, 2011). Airports can apply for additional AIP funding through discretionary grants, which the FAA awards to high-priority needs (FAA, 2011). Funds can be used for any eligible airport planning or development project outlined

in the FAA's national plan. Eligible regional planning organizations, such as metropolitan planning organizations (MPOs) or multistate, airport, and MPO consortiums, can apply for discretionary grants to complete regional aviation systems plans (RASPs). From 1992 to 2009, 32% of total AIP funding went to runway construction, while less than 2% supported planning activities (FAA, 2011, Appendix D).

At a local scale, an airport sponsor is typically the city or county government or a specially designated airport authority that has managerial control of the airports. In the United States, the airport sponsor maintains facilities, manages daily operations, and plans and champions airport development projects. In general, the airport sponsor's first effort toward airport expansion occurs during a master planning process, which produces an airport master plan[4] (FAA, 2007a).

Once an airport begins master planning, the FAA and airport work together. In addition to offering financial support for airport development, the FAA must approve airport master plans, although approval signals only that a plan conforms to FAA standards and does not guarantee funding (FAA, 2007a). Significantly, the FAA also oversees compliance with the environmental review process required by the National Environmental Policy Act (NEPA). The FAA and the airport together prepare an EIS for an airport capacity expansion, but the FAA ultimately approves the EIS[5] (see Wyatt & Schneck, 2014).

The Role of Regional Planning Agencies

Regional planning organizations play a varied role in planning airport capacity across the United States. Regional planning organizations with a large or medium hub airport can be approved by the FAA to receive funds to engage in regional aviation system planning (FAA, 2004a; Fritsche, 2009) and prepare a RASP that complements FAA and airport plans. The regional planning organization conducting a RASP will generally study the regional outcome of demand management (how will regional airports absorb flights that are no longer accommodated by the hub?), not the specific mechanism used to achieve the outcome (should the hub airport use peak pricing or operations caps to limit capacity?). However, they may opt to study the mechanism as well. Elements of the RASP may be incorporated into an airport master plan or an EIS, depending on specific circumstances (GAO, 2009).

As of 2009, six regions with airports either experiencing or forecast to experience excessive delays prepared RASPs (GAO, 2009). In four of the regions, the regional agency studied the potential to redistribute flights from their large hub airport to less congested airports in the region. There is a contextual nature to airport planning: The San Francisco Bay Area MPO prepared an extensive RASP effort with a study of demand management; the Chicago region does not have a RASP despite containing multiple commercial airports; and RASP planning for the New York metropolitan area airports is performed by a nonprofit planning organization rather than a regional organization (GAO, 2009).

All airports must conduct an EIS to obtain FAA funds, but not all regions seeking airport expansion must or do conduct a RASP. Even among those that do, there is no guaranteed link between the RASP, funding by FAA, and the EIS, which is also funded and conducted in part by the FAA.

Demand Management in Environmental Impact Statements

Research Approach

Forty years after Sax's critique that airport EISs do not explore demand management, we evaluate the extent to which demand management is considered as an alternative to capacity enhancement. We ask: a) to what extent did the 19 airport projects completed or planned at airports of national significance since 2000 incorporate demand management in the NEPA process and b) why demand management was overlooked repeatedly as a feasible alternative to new runways.

EIS Components Overview

In conducting an EIS, the FAA and the airport work together in defining the project objective (with a purpose and need statement), selecting alternatives to the preferred project design, and analyzing the alternatives (Wyatt & Schneck, 2014). The purpose and need statement in the EIS defines the objectives to be achieved by the proposed project (purpose) and the overarching problems that motivated the project (need). After the FAA approves the purpose and need statement, the airport sponsor proceeds with the alternatives analysis with the assistance of the FAA. The EIS alternatives analysis must evaluate the environmental impacts of the proposed project, the feasible project alternatives, and the no-build scenario.

Airports begin the alternatives analysis by assessing a number of alternatives (*considered* alternatives), some of which do not advance to the next stage for environmental impact analysis. Considered alternatives must satisfy the EIS's purpose and need statement and meet some measure of practicality to become *feasible* alternatives. All feasible alternatives are evaluated for a full range of environmental and socioeconomic impacts, such as air quality, noise, environmental justice, and cultural resources (for a full description of impact categories, see Blakey, 2006, Appendix A).

EIS Data Sample

We collected EISs for new and extended runways at all major U.S. airports. We then cataloged those airports that a) do not discuss demand management as an alternative, b) at least consider demand management as an alternative, and c) advance demand management as a feasible alternative.

We limited our sample to the 35 major U.S. airports classified by the FAA as nationally significant.[6] In 2009, the top 35 airports served more than 70% of the passengers in the U.S. aviation system (FAA, 2011). In addition, these airports are nationally significant because their congestion and delay can propagate and cause delays at airports around the world (GAO, 2010). According to the FAA, demand management should only be a consideration at the most congested airports (FAA, 2007d). Thus, our data sample only reflects airports that, according to the FAA, can be reasonably expected to assess demand management as an alternative to new capacity.

Next, we limited our sample to the 19 airports listed in Table 1 that deployed new runway capacity or began planning for new runway capacity after 2000 (as opposed to those who funded new infrastructure other than a runway). Orlando (MCO) and Portland (PDX) were not required to complete an EIS by the FAA, thus limiting our sample to 17 airports. Table 1 shows the project development details and the extent to which demand management was considered. Table 1 notes airport name and airport code; hereafter, we identify airports by their metropolitan area and their airport code.

The 17 airport projects[7] with a completed EIS present an opportunity to evaluate tradeoffs between capacity expansion and demand management. We find that six of the EIS documents did not address demand management strategies at all. The EISs from 10 airport projects did assess demand management as a considered alternative, but did not advance demand management as a feasible alternative for an environmental analysis. Only one airport, the Massachusetts Port Authority's (Massport) Boston Logan International Airport (BOS), evaluated demand management as a feasible alternative. In summary, 16 of 17 projects did not document the environmental, socioeconomic, and operational tradeoffs between expanding capacity and demand management.

Demand Management Deemed Feasible: The Singular Case of Boston Logan International Airport

Across the 17 airport EISs we evaluated, Massport is the sole airport sponsor to advance demand management as a feasible alternative to a new runway in the Boston Logan International Airport EIS (FAA, 2002a).

Boston, like many airports, experiences a capacity gap in both good and bad weather as northwest winds could decrease airport capacity by 40% to 60%. Massport proposed an additional runway[8] for use during high winds; in its analysis of alternatives, Massport proposed demand management as a feasible alternative. Massport investigated two different two-part landing fee structures and simulated their effects on airline flight schedules (FAA, 2002a). While Massport did not select demand management as the preferred alternative (and Boston opened a new runway in 2006), it retained demand management in the EIS as a mitigation[9] measure. That is, Massport planned to use a demand management program (peak fees) to mitigate remaining problems even after the new runway was in operation. As of 2014, the mitigation plan remains in place, but there has not yet been a need to enact the peak fee.

Airport Planning: A Focus on Delay, Not Growth

As Table 2 shows, the purpose and need statement that defines Boston's EIS is arguably the broadest statement across the 17 EISs. Instead of focusing on accommodating growth, the airport looked outward to the entire aviation system. A key difference between this purpose and need statement and others is that the focus was purely on delay and closing the gap between good and bad weather capacity. Unlike the other 16 EIS purpose and need statements, Massport did not include a statement about providing sufficient capacity to accommodate future levels of aviation demand.

To accommodate additional growth in passenger demand, Massport discussed increased use of intercity rail and regional airports in Manchester, New Hampshire, and Providence, Rhode Island. Massport calculated that passenger shifts to rail and regional airports could reduce passenger demand at Boston's Logan Airport by approximately 7 million passengers in 2015, while still allowing these passengers to travel to the region (FAA, 2002b). Massport specifically supported a "regional transportation policy to improve the efficient use of the region's transportation infrastructure by expanding use of regional airports" and acknowledged that regional planning efforts supported their understanding of available capacity (FAA, 2002b, p. 21).

Regional Planning: A Focus on Regional Growth, Not Hub Growth

Running parallel to Massport's EIS was the formation of the New England Airport Coalition and their

Table 1. Summary of runway projects at major U.S. airports, 2000–2013.

Airport name	Airport code	Project	Demand management in EIS?
Hartsfield Jackson Atlanta International Airport	ATL	New fifth runway and associated projects	Demand management not retained for detailed evaluation
General Edward Lawrence Logan International Airport	BOS	New runway with airside improvements	Demand management evaluated and initiated as mitigation activity
Cleveland Hopkins International Airport	CLE	Replacement runway, runway extension, and associated development	Demand management not retained for detailed evaluation
Charlotte Douglas International Airport	CLT	New parallel runway and associated projects	Demand management not retained for detailed evaluation
Cincinnati/Northern Kentucky International Airport	CVG	New north–south parallel runway and associated projects	Demand management not retained for detailed evaluation
Denver International Airport	DEN	New sixth runway, final phase of new airport construction	No discussion of demand management
Detroit Metropolitan Wayne County Airport	DTW	New parallel runway and associated projects	No discussion of demand management
Fort Lauderdale–Hollywood International Airport	FLL	Runway expansion and other associated airport projects	Demand management not retained for detailed evaluation
Washington Dulles International Airport	IAD	New runways, terminal facilities and related facilities	No discussion of demand management
George Bush Intercontinental Airport	IAH	New runway and near-term master plan improvements	Demand management not retained for detailed evaluation
Los Angeles International Airport	LAX	Runway relocations and extensions, taxiway	Demand management not retained for detailed evaluation
Orlando International Airport	MCO	New fourth runway	FONSI, no EIS
Miami International Airport	MIA	New parallel east–west runway and associated projects	Demand management not retained for detailed evaluation
Minneapolis–St. Paul International Airport	MSP	New north–south runway and associated projects	No discussion of demand management
Chicago O'Hare International Airport	ORD	Four runway replacements and two runway extensions with substantial airfield reconfiguration for the O'Hare Modernization Program	Demand management not retained for detailed evaluation
Portland International Airport	PDX	Runway extension and runway rehabilitation	FONSI, no EIS
Philadelphia International Airport	PHL	New runway with two runway extensions and associated projects for the capacity enhancement program	Demand management not retained for detailed evaluation
Seattle–Tacoma International Airport	SEA	New runway with runway extension and associated projects	No discussion of demand management
Lambert–St. Louis International Airport	STL	New parallel runway with associated projects	No discussion of demand management

Note: EIS = environmental impact statement; FONSI = finding of no significant impacts.

subsequent RASP effort. The coalition formed in 1994 and included the six New England state aviation agencies, all airport sponsors with scheduled jet passenger service (including Massport), and the New England Council.[10] The coalition published Phases 1 and 2 of the New England Regional Air Service Study (NERASP)[11] in 2002 and 2006, respectively (New England Airport Coalition, 2006). Both phases of the NERASP study analyzed how the system of regional airports in New England could accommodate future travel demand through a "system of underutilized regional airports" (New England Airport Coalition, 2006, p. 1).

Table 2. Purpose and need excerpts from environmental impact statements supporting U.S airport runway development.

Airport name	Airport code	Purpose and need excerpt
Hartsfield Jackson Atlanta International Airport	ATL	The purpose of the Sponsor's proposed project is to reduce current and future all-weather airport operating delay by providing sufficient airfield capacity through 2010 to accommodate most aircraft types during all weather conditions (FAA, 2001a).
General Edward Lawrence Logan International Airport	BOS	Considering the magnitude of aircraft delays at Logan over the years and FAA's responsibility to provide for orderly and efficient air traffic control at Logan, it is appropriate for FAA to do its part to reduce aircraft delays at Logan. A significant cause of Logan delays is northwest winds, when the airport must shift from a north–south, three-runway configuration to an east–west, two-runway combination. (Another cause of delays is an inefficient taxiway system that causes ground delays.) The purpose of the Airside Projects is to reduce delays caused by these conditions. The proposed reductions in approach minimums will also enhance safety and improve runway reliability (FAA, 2002b).
Cleveland Hopkins International Airport	CLE	The purpose of the Proposed Action is to meet the following needs: • The need to enhance safety and operational capability of the airport by providing a runway layout which meets current FAA design standards to the extent practicable; • The need to reduce unacceptable levels of delay and provide sufficient airfield capacity including peak operating periods; • The need to provide sufficient runway length to accommodate current and reasonably anticipated air transportation demand; • The need to provide sufficient terminal gate capacity for commuter aircraft, and domestic and international jet aircraft; • The need to enhance the flow and capacity of the on- and off-airport roadway systems to accommodate existing and future traffic growth; • The need to provide sufficient ancillary facilities to accommodate the current and reasonably anticipated air transportation demand; • The need to enhance the human environment by reducing noise and other impacts on the surrounding communities (FAA, 2000a).
Charlotte Douglas International Airport	CLT	The purposes of the proposed project are for the airport sponsor to increase capacity, reduce delay, lessen noise impacts, provide a runway system capable of supporting long haul international flights and provide landside facilities to support the projected growth in aviation demand (FAA, 1999).
Cincinnati/Northern Kentucky International Airport	CVG	The proposed improvements actions are necessary to increase airfield capacity, which would reduce delays at CVG, to accommodate existing and projected growth in aircraft operations and existing and projected hub operations. In addition, the proposed improvements are designed to accommodate air transportation demand for long-range aircraft departures to Asia or Eastern Europe and projected growth in passenger enplanements, as well as to provide for other related airport development (FAA, 2001b).
Denver International Airport (formerly Stapleton International Airport)	DEN	Numerous studies over the past decade dealing with Stapleton International Airport and its ability to serve future demands, have concluded that three principal issues, capacity, delay, and noise, prohibit Stapleton from adequately meeting the future aviation needs of the Denver metropolitan area. . . . Based on the historical level of activity at Stapleton, the growth of that activity over the past decade, the level of delays experienced at Denver as activity has grown, and the forecast of expected aviation activity levels at Denver, the need for expanded airport capacity is clear (FAA, 1989b).
Detroit Metropolitan Wayne County Airport	DTW	The growth in passengers and air traffic has resulted in an increase passenger processing inconvenience, delay and congestion. . . . The proposed development is to be undertaken by Wayne County in order to provide services and facilities necessary to meet existing and future air transportation needs of the Greater Metropolitan area and the surrounding region (FAA, 1989a).
Fort Lauderdale–Hollywood International Airport	FLL	The purpose of the proposed action is to provide sufficient capacity for existing and forecast demand at FLL with an acceptable level of delay (FAA, 2008b).
Washington Dulles International Airport	IAD	The purpose of the project, from the Federal perspective, is to support the development of IAD such that it will safely accommodate the projected future aviation activity demand levels, without that aviation activity incurring unacceptable levels of aircraft operational delay, thereby causing resultant delays throughout the National Airspace System (FAA, 2005a).
George Bush Intercontinental Airport	IAH	The proposed improvements will reduce aircraft delay, enhance passenger levels of service, and maintain the airport's ability to serve as an airline connecting hub through the 20-year forecast period and beyond (FAA, 2000b).

(*Continued on next page*)

Table 2. Purpose and need excerpts from environmental impact statements supporting U.S airport runway development (*Continued*).

Airport name	Airport code	Purpose and need excerpt
Los Angeles International Airport	LAX	The overall purpose and need of the proposed Master Plan improvements was identified as a need to accommodate projected aviation demand levels within the service area for LAX while maintaining the commercial international gateway role of LAX and the City of Los Angeles. In addition, the Master Plan improvements were intended to enhance the safety and efficiency of the airfield and airport, while improving the level of service (FAA, 2005c).
Miami International Airport	MIA	The purpose of the proposed project, to meet current and forecast air carrier and passenger demand at MIA and to enhance the capacity of the national system of airports, is accepted (FAA, 1998c).
Minneapolis–St. Paul International Airport	MSP	The broad purpose of the Minnesota Dual Track Airport Planning Process is to provide efficient and economical movement of people and goods between the Minneapolis–St. Paul area and national and international markets, and help promote the orderly growth and economic development of the region. The state's Metropolitan Airport Planning Act of 1989 also stated that the airport's actions must satisfy the air transportation needs of the region to the year 2010, and there must be a concept plan that could assure that the air transportation needs of the region are met to the year 2020 (FAA, 1998b).
Chicago O'Hare International Airport	ORD	Address the projected needs of the Chicago region by reducing delays at O'Hare, and thereby enhancing capacity of the National Airspace System (NAS). Ensure that existing and future terminal facilities and supporting infrastructure (access, landside, and related ancillary facilities) can efficiently accommodate airport users (FAA, 2005b).
Philadelphia International Airport	PHL	The purpose of the Capacity Enhancement Program is to enhance airport capacity in order to accommodate current and future aviation demand in the Philadelphia Metropolitan Area during all weather conditions (FAA, 2010).
Seattle–Tacoma International Airport	SEA	The purpose of the proposed action is to reduce existing and forecasted poor weather aircraft operating delay and would accommodate forecasted growth in passengers, cargo, and aircraft operations (FAA, 1997).
Lambert–St. Louis International Airport	STL	The purpose of the proposed action is to: (1) enable Lambert to effectively and safely accommodate projected levels of aviation activity at an acceptable level of delay by increasing airfield capacity, improving visual flight rules (VFR) capacity, allowing dual simultaneous independent instrument flight rules (IFR) arrival operations, and decreasing delays. (2) enhance the National Airspace System (NAS) by reducing delays nationwide and increasing airfield capacity. (3) recognize the importance of the economic benefits provided by Lambert and allow the local communities and the region to continue to reap those economic benefits. (4) facilitate the airline hub at St. Louis, which is vital to alleviating projected shortfalls in capacity at Lambert and in the NAS. This is interrelated with all of the above purposes for the proposed project (FAA, 1998a).

NERASP found that New England's regional airport system had the ability to meet passenger demand through 2020, showing Massport how regional airports would absorb the flights that Boston could not accommodate. This allowed Massport to incorporate regional dynamics into their EIS assessment of demand management. NERASP not only had an impact on Massport's capacity planning, but also affected national capacity planning; building on the NERASP's findings, FAA included regional solutions in the 2009–2013 strategic capacity plan (as stated by the FAA Adminstrator in New England Airport Coalition, 2006, p. 2; FAA, 2008a). In summary, NERASP proved a valuable planning document that demonstrated the ability of regional airports to allow for regional economic growth when the hub airport capacity is stagnant (GAO, 2009).

Demand Management Overlooked or Deemed Infeasible

Turning our focus to the remaining airport sponsors that did not advance demand management, we explore the overarching barriers to evaluating demand management as a feasible alternative in EISs.

Narrow Purpose and Need

The purpose and need statements for the 16 EISs that did not advance demand management as a feasible alternative have a common theme: accommodating growing flight demand while keeping delay at an acceptable level, as shown in Table 2. An EIS with a purpose and need defined strictly in terms of physical capacity requirements will undoubtedly lead the airport and the FAA to reject demand management—and any other non-build policies—as a feasible alternative. Thus, the highly detailed purpose and need statements in the EISs effectively inhibit an airport from taking any account of alternatives that do not expand capacity. So Cincinnati/Northern Kentucky (CVG), with the goal of accommodating projected growth in airport operations, or Cleveland (CLE), with the goal of building a longer runway, did not evaluate demand management strategies as valid alternatives.

Narrow purpose and need statements are indicative of a deeper conflict in the NEPA process, one between

NEPA's procedural requirements and substantive objectives. If airport sponsors narrowly limit the selection of feasible project alternatives, they may be following the letter of NEPA law (procedure) but not its spirit of environmental stewardship (substance). A broad range of legal research suggests that lawsuits offer an efficient tactic to enforce compliance with NEPA paperwork and documentation (procedure), yet offer little enforcement of environmental values in decision-making (substance; see Andreen, 1989; Bartlett, 2000; Blumm, 1990; Hartmann, 1994; Karkainnen, 2002, 2004; Lindstrom & Smith, 2001; Murchison, 1984; Rabin, 1986; Yost, 1990). In a comprehensive review of airport expansion case law, Wyatt (2011) finds that legal challenges to the FAA's selection of feasible and preferred alternatives are ineffective. Judges generally defer to the FAA's discretion in approving the purpose and need statement and in interpreting the feasibility of alternatives (Angel, 2002; Bass, Herson, & Bogdan, 2001; Hartmann, 1994). Airport managers have strong incentives to create documents that can be defended on procedural grounds because substantive questions of sustainability are rarely successfully challenged in court.

The NEPA process, however, is positioned to instigate significant change when federal agencies incorporate substantive NEPA values. Blumm (1990) and O'Brien (1990) highlight a 1986 EIS by the U.S. Forest Service documenting the hazards of herbicides. The "good faith analysis of reasonable, environmentally superior alternatives to herbicide spraying" prompted the agency to radically change their herbicide policy (Blumm, 1990, p. 468). In this case, the U.S. Forest Service harnessed the EIS's potential to identify environmentally innovative solutions. In contrast, the FAA's narrow purpose and need statements limit opportunities to explore alternatives to new runways, thus limiting the possibility to uncover its own environmentally innovative solutions.

Surface transportation offers examples of planning interventions that broadened the purpose and need statements of the EIS to reflect regional interests and environmental values. Marcucci and Jordan (2013) discuss a highway project in Maryland where green infrastructure planning influenced the framing of the purpose and need statement to explicitly include a goal to remedy past environmental damage. Senner (2011), Amekudzi and Meyer (2006), and Barberio, Barolsky, Culp, and Ritter (2008) argue in favor of incorporating systems-level planning decisions into NEPA's project-level analysis. With this approach, there is greater opportunity for regional planners to incorporate regional concerns in the EIS alternatives analysis and introduce a regional focus in the purpose and need statement. Massport integrated regional planning documents into the NEPA process early on, its broad EIS purpose and need statement clearly standing out among aviation projects.

Policy Conflicts and Uncertainty

Four of the 11 EISs that initially considered demand management as an alternative cited legal uncertainties as a reason to not advance demand management as a feasible alternative. Of the 11 EISs that considered demand management, three (Fort Lauderdale–Hollywood [FLL], Chicago [ORD], and Philadelphia [PHL]) discussed how federal law explicitly promotes capacity building. For example, the Chicago EIS served as a reference point for other airports interpreting FAA policy regarding demand management. The FAA temporarily reinstated a cap on the number of flights at Chicago due to surging traffic, but stated that their "preferred approach to reducing delay and congestion is increasing airport infrastructure" (Congestion and Delay at Chicago O'Hare International Airport, 2005, p. 15529). Chicago included this FAA statement in the EIS alternatives analysis for a new runway and airfield reorientation. Chicago ultimately did not advance demand management as a feasible alternative (the FAA discontinued the caps when the new runway was constructed). The Philadelphia EIS borrowed this exact language in their alternatives analysis to justify not advancing demand management as a feasible alternative.

There are also federal restrictions on airport revenue. In general, the FAA prohibits airports from generating revenue in excess of their costs. In their initial discussion of demand management as a considered alternative, three airports (Cleveland [CLE], Charlotte [CLT], and Fort Lauderdale–Hollywood) asserted they could not charge a peak-period congestion fee that would be high enough to encourage airlines to shift flights to the off-peak without violating this rule.

Demand management is legal and possible to implement, yet the FAA's pro-build policies allow airports to cite policy conflicts and refuse to advance demand management as a feasible alternative. In contrast, RASP efforts can circumvent policy conflicts; since these planning studies occur outside the NEPA process, FAA policy does not deter RASP planners from exploring alternatives to enhancing capacity. Moreover, RASPs typically do not define a demand management mechanism and study its impact. Instead, they study ways in which regional airports can accommodate future air transportation demand, sometimes outlining potential demand management mechanisms that encourage a redistribution of traffic. The 2011 RASP prepared by the Metropolitan Transportation Commission (MTC), the MPO for the San Francisco Bay Area, does just this[12]

(Regional Airport Planning Committee, 2011). In short, regional planning agencies can examine and demonstrate demand management tradeoffs outside the NEPA process and provide this knowledge to airports and the FAA to guide demand management through the NEPA process.

Economic Development and Airline Hub Service

The link between airports and economic development has roots in the early years of U.S. airport development in the 1920s. Bednarek (2001) writes that "a city had to have [an airport] in order to achieve its 'destined' growth and development to match or, better, overwhelm its urban rivals" (p. 7). Airports may provide measurable economic development (such as that found by Brueckner, 2003), but, just as significantly, they also provide intangible benefits such as civic pride and strength. The force of urban boosterism driving airports to build capacity remains today, which we see in airport EIS documents that put significant focus on growing operations to preserve their hub status.

As Table 2 illustrates, the purpose and need statements from the EISs across all airports show that building capacity to enhance the airport's ability to accommodate flights and, in some cases, remain a hub airport, is the most frequently cited reason for a project. Sixteen airports stated the need to accommodate increases in demand, 13 discussed the need to reduce delay, and three stated the need to enhance safety[13] in their EIS purpose and need statements. Eleven airport sponsors—of which only eight remain hubs as of 2014–explicitly cited their desire to protect the hub operation of their hub airline in their EIS. Of these 11, eight are airports that considered demand management and cited their hub status as a reason to not advance demand management as a feasible alternative.

Protecting a hub operation and accommodating forecast demand appears to garner the largest focus in the purpose and need statements and in the discussion of why demand management is not feasible. Delay is also cited as a factor for not advancing demand management. For example, Atlanta (ATL) and Chicago noted that demand management (which constrains airport capacity) would not sufficiently reduce delays caused by unconstrained demand (which assumes there are no constraints on airport capacity). Philadelphia stated that it could not charge a fee in a congestion pricing scheme that was high enough to decrease delay substantially. Interestingly, we did not find an airport that contended demand management would degrade safety conditions.

Without a study of whether accommodating a hub airline guarantees loyalty (and business), whether the environmental impacts of constructing and operating a larger airport are offset by the promise of business growth, or whether certain actions affect aviation safety, the tradeoffs between demand management and capacity enhancement remain unknown.

Summary and Conclusions

We investigate the extent to which airport EISs include a comprehensive analysis of demand management as an alternative to capacity enhancement. We find that Massport was the single airport, of 17 EISs studied, that conducted a comprehensive analysis of demand management. We also find that a regional aviation systems planning process played a significant role in enabling Massport to analyze demand management in its EIS. The plan developed by that process, NERASP, showed how regional economic development would flourish if flights were spread across the region because NERASP authors were not constrained by an analysis of the legalities of demand management. Thus, planners' efforts paved the way for Massport to focus on possible demand management strategies in their EIS document.

We identify three overarching barriers preventing the remaining airports from performing a comprehensive analysis of demand management in their EISs: narrow project objectives, uncertainty over demand management policy, and concerns regarding economic development. We explore ways in which regional planning efforts, and particularly RASPs, can help surmount these barriers by influencing airport capacity planning early in the process, studying the impact of demand management on a system of regional airports, and quantifying the economic development potential of managing demand at the region's major hub airport.

The results of this study suggest that regional aviation systems planning should tap into and coordinate with regional planning efforts. More specifically, regional planning processes can be framed to inform NEPA studies and influence federal policies on airport development. In her seminal work on environmental impact assessment, Steinemann (2001) insists that the environmental review process must "permit consideration of alternatives that may be outside the scope of the agency's stated objectives" and "alternatives should better reflect societal goals, not just narrow agency goals" (p. 18). Regional planners are trained and positioned to consider and prioritize broader societal goals. Moreover, they have greater latitude than those writing EIS statements to recommend innovative actions that stray from the traditional goals of airports and the FAA.

Based on these findings, we focus our recommendations on actions that strengthen the influence and agency of regional planners in federal, regional, and local aviation planning processes.

First, we recommend that the FAA play a more direct role in funding and advocating for regional aviation systems planning. In the long term, we recommend the FAA work toward drafting federal legislation that requires participation in the RASP process as a condition for nationally significant airports to receive federal AIP funds. Absent congressional mandate, the FAA can still strongly encourage, facilitate, and fund regional aviation systems planning, especially in regions that contain at least one airport of national significance. Internally, we recommend the FAA elevate the priority of regional aviation planning (and thus the funding allocation from AIP) so that more regional planning organizations apply for and receive AIP discretionary grants. A RASP demonstrating that expanding capacity may not be needed could potentially save hundreds of millions of dollars in AIP funding for runway construction costs, thereby providing justification for RASP funding.

In the short term, we recommend the FAA encourage the creation of regional aviation planning coalitions in regions with a nationally significant airport. These organizations can maintain a more comprehensive focus on regional growth than airport sponsors, who are more frequently concerned with growing airline service at their airport. The FAA could spearhead a national coalition of regional aviation systems planning experts—possibly from organizations with ongoing RASP processes or that have performed RASPs—to assist local aviation coalitions in preparing their RASP. The FAA should participate in, but not lead, regional aviation systems planning efforts. All evidence suggests that if regional planners played a greater role in the airport planning process, airports and the FAA would make more informed policy decisions based on a comprehensive analysis of the full benefits and impacts of demand management.

Second, we recommend that regional planners play a more direct role in airport EIS analysis. The surface transportation field offers a legal precedent to connect regional planning with the NEPA process. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) includes provisions that "create conditions for early planning and decision making at the regional and community levels before the NEPA process, including scoping, begins" (Senner, 2011, p. 503). Absent equivalent aviation legislation, local coalitions and FAA leaders can still instigate early collaboration and integrated planning. Ultimately, RASPs should help guide the alternatives analysis in an airport's EIS. Regional agencies can draft recommendations for broader purpose and need statements in anticipation of projects that will have regional significance.

Third, the FAA can also choose to make demand management a mandatory alternative to undergo environmental analysis in EISs, similar to the no-build scenario, with the understanding that regional coalitions would be available to support the analysis. Including demand management as an alternative would not require airports to implement demand management, but would ensure that the airport sponsor assesses demand management in the EIS.

With some creative thinking, airport planners could create a regional planning process that improves the substantive value of environmental impact statements, inspires changes to FAA policy, and provides critical knowledge of unexplored alternatives to capacity enhancement. EIS methods in aviation planning are not set in stone: If new ideas and new people come to the table, more environmentally innovative solutions to airport congestion may arise.

Acknowledgments

We would like to thank Erick Guerra, Andrew Churchill, and four anonymous reviewers for their insights and feedback. The authors alone are responsible for any errors or omissions.

Notes

1. Airlines use the hub-and-spoke model to consolidate passengers with different origins and destinations (spokes) by passing them through the same connecting airport (hub). As a result, passengers with different origins and destinations share some of the same flight segments, enabling airlines to use larger aircraft. Rather than operating a large number of small point-to-point flights, the airlines use hub-and-spoke networks to exploit aircraft cost economies of scale and economies of density (Nero, 1999; Ryerson & Hansen, 2013; Ryerson & Kim, 2013).

2. Through its National Plan of Integrated Airport Systems (NPIAS), the FAA evaluates the entire American system of airports, reporting on potential development and summarizing system performance (FAA, 2011).

3. The Airport and Airway Revenue Act of 1970 created the Airport and Airway Trust Fund, which is funded by passenger ticket taxes and aviation fuel taxes. The Airport and Airway Improvement Act of 1982 established the Airport Improvement Program (AIP). AIP funds support a broad range of activities, including runway development and master plan studies. Airport sponsors receive apportioned AIP funds based on formulas defined by Congress. Apportioned funds can be used for any eligible airport planning or development project outlined in the FAA's NPIAS report. Airport sponsors can apply for additional AIP funding through discretionary grants, which the FAA awards to higher-priority needs (FAA, 2011).

4. An airport master plan is a detailed, long-term development plan that outlines the sponsor's strategy for future development. Airport layout plans, an outcome of master planning, are sent to the FAA for approval; approval is necessary for the airport to be eligible for federal funds. An

airport may study the delay impacts of expanding airport capacity in their master plan, which serves as a first step by the airport to initiate an expansion (FAA, 2007a).

5. The lead agency for EIS preparation ultimately serves as the approving agency. The FAA functions as the lead agency for AIP-funded projects because the AIP spending is a decision made by the FAA; it is therefore the FAA's responsibility to prepare a legally sufficient EIS. In some cases, another federal agency may function as a cooperating agency. Lead agencies may transfer some authority or responsibility to a cooperating agency with appropriate legal jurisdiction or expertise. For example, the Federal Highway Administration functioned as the cooperating agency for the relocation of the Denver airport. Federal agencies that are not invited as cooperating agencies may comment either during the public participation phase of an EIS or during special opportunities created for participating agencies. Public commenters and participating agencies do not have authority to "sign off" or "approve" the airport EIS (FAA, 2006b).

6. In 2011, the FAA transitioned from the top 35 airports (known as the Operational Evolution Partnership airports, or OEP) to the Core 30 airports, eliminating 5 of the original 35 OEP airports that no longer serve as airline hubs (Marks, 2012). The FAA identifies the OEP 35 and the Core 30 airports for their national significance in the U.S. air transportation system, largely based on traffic flows.

7. Sixteen of the airports contain at least one of the following actions in the EIS's project description: a new runway, a runway extension, or a runway relocation. The 17th airport in our sample, Denver, involved the complete relocation of the airport.

8. The reader is referred to Coogan et al. (2010) for additional information on Massport's capacity planning process and Marchi (2005) for a background on the numerous legal battles during the capacity planning process.

9. Massport designed the mitigation plan to manage delays and environmental impacts, particularly noise. The demand management program was structured to function as a collaborative, proactive program between the airport sponsor and airlines (Massport, 2004). Using flight schedules collected six months in advance, Massport can simulate future traffic at the airport on a typical fair-weather day. If delays exceed an average of 15 minutes per flight over three consecutive hours, the airlines would be encouraged to voluntarily reduce their schedule and resubmit a schedule to Massport. Massport would again simulate a day of traffic at the airport using the revised schedules. If delays continued to exceed the threshold, the airlines would be notified that the pre-established flat peak fee would be added to the landing fee.

10. The New England Council is a "non-partisan alliance of businesses, academic and health institutions, and public and private organizations throughout New England formed to promote economic growth and a high quality of life in the New England region. The New England Council's mission is to identify and support federal public policies and articulate the voice of its membership regionally and nationally on important issues facing New England. The Council works to foster positive working relationships between its members and key federal policy makers, including members of Congress and leaders of key federal agencies" (The New England Council, 2014).

11. NERASP is a RASP funded by FAA AIP discretionary grants totaling $2.5 million ($1.4 million in fiscal year 2001; $1.1 million in fiscal year 2004). The first phase of the study was initiated in 2001 and published in 2002; the second phase of the study was initiated in 2004 and published in 2006 (FAA, 2004b, 2006a, 2007b, 2007c, 2009).

12. The study outlines how the Bay Area regional airports were able to accommodate the highest regional aviation demand forecast for 2035, focusing on the broader outcome of a demand management program. The study authors present different mechanisms that might encourage traffic to shift from San Francisco, but do not focus on the details of implementing a demand management program (Regional Airport Planning Committee, 2011).

13. In addition to the three airport sponsors that stated the need to enhance safety, three other airport sponsors cite the need to safely accommodate increases in demand.

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