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Remote Towers: A Better Future for America's Small Airports

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Executive Summary

In today's aviation industry, advancements in air traffic control technologies and procedures promise to enhance safety and efficiently accommodate demand from commercial airlines and general aviation. Although having an air traffic control tower is not required for airline service in the U.S., a tower provides benefits of increased safety as well as assurance for the business community that the area served by the airport is credible and "on the map."

Most small airports that have towers are served by contract towers, approved by the Federal Aviation Administration (FAA) and operated by various private companies, often using former military and FAA controllers. Studies by the U.S. DOT's Office of the Inspector General find that contract towers provide equivalent service to FAA-operated towers at airports with comparable activity levels—but cost only 26% as much to operate. The FAA contracts with these firms, paying for the costs of air traffic controllers, with the private companies typically paying the balance of operating costs. Small airports qualify for a contract tower only if the FAA finds that the benefits exceed the costs (i.e., a benefit/cost ratio of at least 1.0).

During the 2013 federal budget sequester, 189 contract towers were scheduled to be shut down for the balance of that fiscal year. But Congress approved an emergency transfer of funds from the FAA's airport grants program (AIP) to the FAA Operations budget, which saved those towers from being shut down. However, at the start of fiscal year 2014, the FAA instituted a moratorium on any additions to the contract tower program. As of now, the waiting list for the program includes as many as 16 small airports. The FAA is also studying revisions to its benefit/cost methodology, though what these will be, when they will be finalized, and how they will be shared are not known.

For some smaller airports, "remote towers" offer a possible alternative. The idea is that instead of constructing a tall building with a control cab on top to house the controllers, just erect a pole with an array of sophisticated video cameras and communications gear, and securely communicate all that information to controllers in a ground-level building housing the control room. Instead of the traditional "out-the-window" view, the controllers would have a panoramic video display of the airfield and its environs. That "remote tower center" could be located at the airport in question, or it could be located at a considerable distance. In the case of low-activity airports, it is possible to locate controllers responsible for several small airports in a single remote tower center.

Simulations by the FAA at its Atlantic City research center in 2007 demonstrated that a remote tower can provide better surveillance at night and in rain, fog, or snow conditions, thanks to the infrared and other camera equipment, and other advanced technologies. Experienced controllers and supervisors preferred the remote tower to a conventional tower after using both during the simulations. Hence, a remote tower can improve safety margins and provide operational benefits compared to a conventional tower. Moreover, the construction cost is significantly lower than building a tall, occupied structure. And in some configurations, the operating costs can be lower, especially in cases where several low-activity airports are controlled from a single remote tower center. With the benefits greater than a conventional tower and the costs lower, a B/C ratio greater than 1.0 will be easier to achieve for many small airports.

Unfortunately, the FAA has no current program to develop and implement remote towers, presumably due to its ongoing budget problems and other priorities. By contrast, remote towers are already in operation in a number of European countries:

- **Sweden** certified the first remote tower operation in the world in 2016, controlling air traffic at Örnsköldsvik from a remote tower center at Sundsvall, 93 miles away. In 2017, it plans to add control of two more small airports from Sundsvall.
- **Norway** is under way in 2017 developing a remote tower center to control traffic at five small airports, with a goal of increasing that to 20 by 2020.
- **Germany** will open its first remote tower center in Leipzig in 2017 to control air traffic at Saarbrücken; that center will subsequently also be responsible for Dresden and Erfurt.
- **Ireland** in late 2016 completed the first operational trial of controlling two airports—Cork and Shannon—from a remote tower center at Dublin Airport.
- NATS, the air traffic control company for the United Kingdom, will replace the current tower at London City Airport with a remote tower. Air traffic for the four-million-passenger airport will then be controlled at Swanwick, about 80 miles away. NATS and its partner Saab will begin construction in 2018 with operations commencing the following year.

The ATC providers in these countries are self-supporting ATC corporations not subject to government budget problems. By contrast, the FAA's chronic budget problems result in it having no remote tower program. The only two U.S. pilot projects—at Leesburg, VA and Loveland, CO—are funded by state and private money. The path forward for remote towers becoming generally available to U.S. airports is unclear.

Hence, the outlook for small airports is unclear under the status quo. Were Congress or the FAA to permanently lift the moratorium on new contract towers, it is unclear where increased budget dollars for the program would come from, given the agency's inability to fund much-needed replacements of its larger, aging facilities such as enroute centers and TRACONs. Likewise, the likelihood of the FAA creating a budget for a new remote towers program seems very low, despite the obvious benefits this would provide to airports of all sizes.

On the other hand, were the Air Traffic Organization separated from the federal budget and made self-supporting from customer charges, like its counterparts in Europe, moving ahead with remote towers would be a simple business decision, as part of overall modernization and facility replacement and consolidation.

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Introduction

Smaller communities across the country rely on air service for a variety of purposes, including inbound tourism and business, and outbound access to key regional, national and global markets. The United States has a robust national system of airports supporting this access, including literally thousands of commercial service and general aviation airports. As of Fiscal Year 2015, according to the Federal Aviation Administration (FAA), the U.S. had 3,333 public-use airports that the agency designated as significant to air transportation.

Most of these airports serve solely general aviation traffic and don't require elaborate airside or air traffic infrastructure. Other aviation traffic—including the clear majority of commercial air traffic, as well as a significant portion of general aviation traffic—requires more-advanced air traffic services. At approximately 500 U.S. airports, these services are provided via an air traffic control tower. Benefits of a tower include streamlined access, reduced delays, and increased safety margins compared to non-towered airports.

At towered airports, air traffic controllers provide instructions on taxiing, departures and arrivals. By contrast, at the more than 20,000 non-towered U.S. airports, collision avoidance and sequencing are the responsibility of the commercial or private pilots who, to operate safely, must monitor a common radio frequency, stay in communication with other pilots, and maintain awareness of an airport's local air traffic procedures.[1]

Since commercial and general aviation pilots are trained to operate at both towered and non-towered airports, the level of safety is not necessarily affected by the presence of a control tower. However, the reality at busy airports is well described by Dave Hirschman writing for the Aircraft Owners and Pilots Association (AOPA):

1 In some instances, pilots may receive advice on their situational awareness from nearby FAA Terminal Radar Approach Control Facilities (TRACONs).

> *The traffic pattern at my formerly non-towered home airport used to resemble a game of chicken. VFR departures on Runway 5 would find themselves beak-to-beak with pilots practicing ILS approaches under the hood in the opposite direction; corporate jets had to find gaps between students practicing touch-and-goes and simulated engine-out landings; and helicopters, gyrocopters, and gliders added to the anarchy in their own unique ways. Now, an FAA contract tower has gone up at Frederick (Maryland) Municipal Airport, and the new sheriffs have made order of previous chaos.*[2]

To create "order out of chaos," operators of smaller airports work hard to obtain towered services for their airports, if the traffic and the complexity of their operations warrant it. This often is the case in metropolitan areas where the complexity of interactions multiply with increasing traffic, and resources like the Common Traffic Advisory Frequency, used to communicate important information among pilots, becomes increasingly congested and tedious to use.

To many of these communities, a tower is also a sign that "we have made it." However, modern control towers can be quite expensive, and the ability of the FAA to fund new towers is tightly constrained. At the extreme end of the continuum, the recently constructed tower at San Francisco International Airport (SFO), for example, cost $151 million with the FAA providing $82 million and the airport $69 million. SFO had 430,000 annual takeoffs and landings at the time ground was broken for the facility. To provide unobstructed sightlines to the airfield required a tower 221 feet tall. While some contract towers have capital costs less than 5% of SFO's, that cost is still prohibitively expensive for many smaller community airports.

The cost of a tower is not the only challenge facing airports seeking to improve their access to the National Airspace System (NAS). Over the last decade, developments in the aviation industry have reduced or eliminated commercial air service to many smaller communities. These developments include the consolidation of network airlines and the associated closure or reduction of service to former hubs, the gradual retirement of 30- and 50-seat regional jets, the focus of network airlines on their principal gateway hubs (feeding lucrative international traffic), and pilot shortages resulting from the FAA's 2013 pilot qualification standards change.

[2] "Dogfight: Tower or No Tower," AOPA Website, April 5, 2013.

Scheduling data illustrate the problem. Between May 2007 and May 2017, average airline seat capacity has fallen at medium hubs (-6%), small hubs (-12%) and non-hubs (-15%), while increasing at the large hubs (+10%), which include airports serving major metropolitan areas (e.g., New York's John F. Kennedy Airport) as well as many of the network airlines' gateway hubs (e.g., Delta's Hartfield Jackson Atlanta International Airport).[3] These results for hub categories are averages across all airports of each type. Many smaller communities have suffered even larger reductions, causing great angst by calling into question the future viability of their markets and any efforts to upgrade their level of air traffic services.

Challenges to the general aviation industry have also hit many smaller community airports, especially those with limited or no commercial service. These airports typically rely on hangar fees and revenue derived from the fueling of aircraft, together with capital assistance provided by the FAA under its Airport Improvement Program (AIP). The Great Recession of 2008 and 2009, dramatic increases and swings in the price of fuel, and other factors led to reductions in general aviation over the last decade. Just as with commercial traffic, the concern of many general aviation operators was that reductions in operations would lead to pressures by the FAA not to maintain levels of service to many of these airports.

Recent headlines about legislation to reauthorize the FAA and its programs have exacerbated small-community concerns about retaining access to the National Airspace System (NAS). This debate over the past two years has centered on the proposed reform of how air traffic service is governed, managed and operated. The Chairman of the House Transportation and Infrastructure Committee, Bill Shuster (R-PA), has proposed that the FAA's Air Traffic Organization be separated from the agency and converted into a federally chartered, independent, and not-for-profit corporation (as many other countries have done over the past 30 years). Rather than collecting revenues from taxes imposed on passengers, shippers, and aviation fuel, the new air traffic entity would recover its costs through fees collected directly from its customers. Regulation and oversight of the new entity would remain with the FAA.

[3] Scheduling data courtesy of OAG On-line, accessed February 2017. The FAA sets the hub definitions as: large hubs as airports with greater than 1% of national traffic; medium hubs as less than 1% but greater than 0.25%; small hubs as less than 0.25% but greater than 0.05%; and non-hubs as airports with at least 10,000 annual enplanements but less than 0.05% of national traffic.

Some critics of Chairman Shuster's proposed ATC reform legislation have claimed that a corporatized ATC provider would threaten the viability of service to smaller airports. The fear is that it would either dramatically raise the fees paid by general aviation to use air traffic services, or that the revamped ATC provider might terminate services at low-activity airports, because they would not be cost-beneficial. Proponents have countered with assurances that general aviation would pay either nothing or on a separate, much-lower-cost fee schedule, and that currently provided air traffic services would continue (as they have in Canada ever since their system was corporatized 20 years ago).[4]

[4] See for example the debate, "In the battle over who controls U.S. airspace, it's big lobbyists vs. small airports" (http://www.mcclatchydc.com/news/politics-government/congress/article136785618.html).

Part 1

Current Control Tower Problems for Small Airports

1.1 Types of Control Towers

There are three different organizational models for U.S. control towers: FAA towers, Federal Contract Towers (FCT) and Non-federal towers. All towers are designed to provide for the safe and orderly movement of aircraft operating at or in the vicinity of an airport, relying on two-way communication between the tower and pilot. Operating at a *non-towered* airport requires pilots to talk directly to each other to manage the flow of arrivals and departures.

Under FAA rules, to be eligible for a tower, airport management is required to:

- Ensure that the airport is open to the public;
- Demonstrate to the FAA that the airport makes a significant impact on the National Airspace System (NAS);
- Agree to a series of assurances and covenants to keep the airport operating over the useful life of the tower;
- Provide the FAA with cost-free land for the tower; and,
- Meet the criteria of FAA's benefit/cost model that weighs FAA costs against the benefits the tower would provide.

The FAA's benefit/cost model has become the key criterion in determining whether an airport can obtain a fully funded FAA tower or a contract tower. The model includes forecasted flight operations and FAA's estimates of tower benefits such as prevented collisions and accidents. Costs include the capital costs of the tower and related facilities, labor costs to operate the tower, and any required overhead from the FAA's Air Traffic

Organization (ATO). Meeting these threshold criteria is necessary but does not guarantee that a community will end up obtaining a control tower.[5]

***FAA Towers** (n=264)* provide services such as approach and departure control to aircraft operating on the surface movement area and in the vicinity of an airport. (In Class D airspace this normally would span five miles around the airport and up to 2,500 feet above ground level.) These services are offered by voice and digital communications, visual signaling and other methods. The FAA has full responsibility for these towers and uses air traffic controllers and other staff, all of whom are FAA employees. Most of the employees, including all Certified Professional Controllers (CPCs), are represented by the National Air Traffic Controllers Association (NATCA), whose salaries are set per collectively bargained agreements negotiated directly between the union and the FAA.

***Federal Contract Towers** (n=253)* encompass two types: fully funded (237) and cost-share (16) towers. They were first authorized in 1982 to re-open low-activity federal towers that had been closed in the aftermath of the strike by members of the Professional Air Traffic Controllers Organization (PATCO). Congress later codified a more wide-ranging program to convert low-activity FAA towers to contract towers. Today, because of the much higher costs of FAA towers, federal contract towers are the most realistic alternative for all but the busiest airports seeking a new tower.

Contract towers operate under FAA regulations in areas such as operational procedures, staffing plans, medical certification, and training of controllers. Airports with contract towers are responsible for the maintenance and utilities of those facilities and, as with San Francisco and many other new federal towers, often contribute significant local and state capital funds for the construction of a tower. Airports seeking to build a new contract tower may also use up to $2 million in available Airport Improvement Program (AIP) grant funds (entitlements and state apportionment) to help pay for the construction and equipment costs of the tower.

Overall, 28% of U.S. tower flight operations (44% of all general aviation operations) occur at contract towers, which make up 14% of the FAA's budget for providing air traffic services. While the origin of the contract tower program focused on low-activity towers, many of the contract towers currently operating have relatively high levels of activity. In fact, 90 contract towers provide services to small and non-hub airports with scheduled airline service,

5 See FAA, *Establishment and Discontinuance Criteria for Airport Traffic Control Towers*, AD-A245241.

including Lihue (Kauai) and Kona (Hawaii), each of which had over three million total passengers in 2016. Other contract towers make what the FAA deems a significant contribution to the NAS by serving as relievers (e.g., Dallas Executive) to major large hub and connecting facilities (e.g., DFW Airport). In addition, 47% of military operations flown in the continental United States are from contract tower airports. Of the 253 contract towers, three contractors are responsible for the operation of 247 of them: Midwest Air Traffic Control Services, Serco Management Services, and Robinson Aviation. Firms bid competitively for five-year contracts to operate the towers.

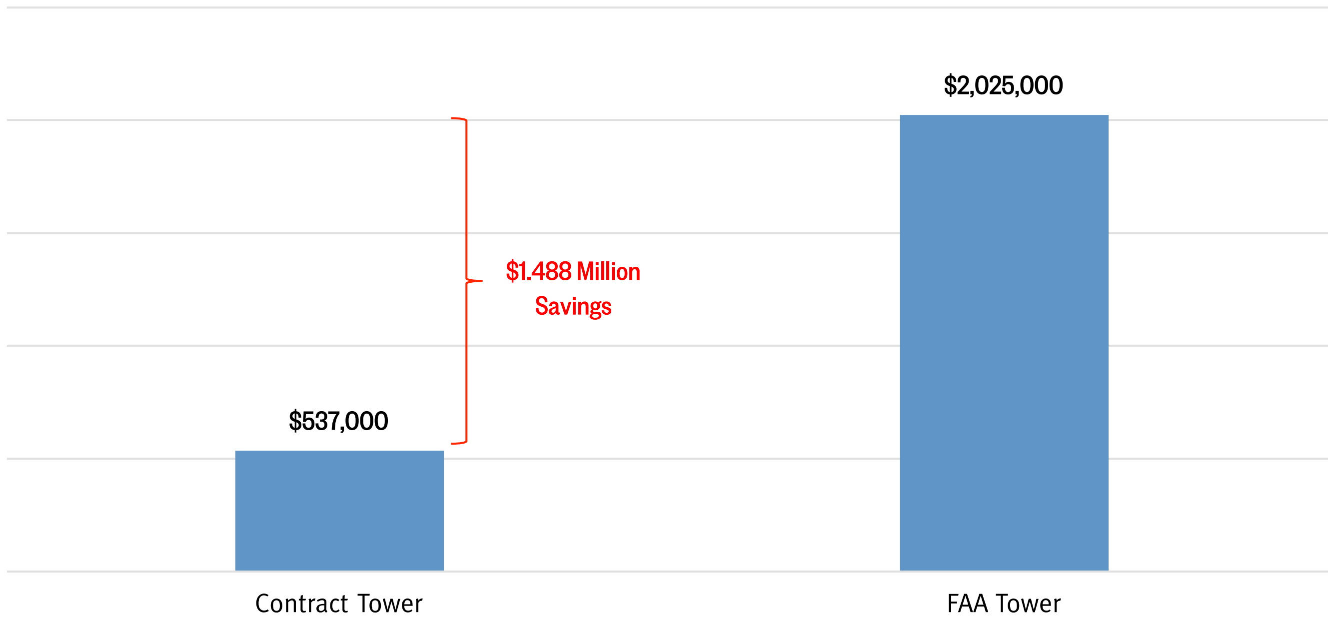
Contract towers provide significant cost savings compared with FAA-operated towers of comparable size and activity level. The savings come from lower required staffing levels and controller compensation and benefits. Staffing levels are set by the contract operator and reviewed by the FAA, while compensation is set per Department of Labor (DOL) wage rates, instead of the terms of the FAA-negotiated contracts for federal towers. In a 2012 report, the U.S. Department of Transportation's Office of Inspector General noted that, for towers of comparable size and flight activity, "the average cost to operate a contract tower in FY 2010 was about $537,000, compared to $2.025 million to operate an FAA tower, a difference of $1.488 million."[6] A review of DOL wage rates for FAA Certified Professional Controllers (CPCs) today reveals a median wage of $58.85 an hour, compared to posted wage rates of contract tower CPCs of between $29.55 and $33.98.[7]

One of the principal reasons for these cost savings is that many contract tower controllers are either ex-FAA controllers (who have retired) or are ex-military controllers. Thus, compared with FAA-operated facilities and towers, contract towers do not have to absorb anywhere near the costs of training and development that FAA facilities do. Even with the lower compensation for contract tower CPCs, controllers' union NATCA has provided conditional support for the contract tower program; today, NATCA represents employees at more than one-third (93) of the facilities.

6 See U.S. Department of Transportation OIG, *Contract Towers Continue to Provide Cost-Effective and Safe Air Traffic Services, But Improved Oversight of the Program is Needed*, Report Number AV-2013-009.

7 See *Occupational Employment and Wages, 53-2021 Air Traffic Controllers,* May 2016 and *https://jobs.serco-na.com/*, the job site for Serco.

Figure 1: Operating Costs: Contract Tower vs FAA Tower (2010)



Policymakers created the contract tower cost-share model in 1998, giving airports the option to obtain a contract tower even if they could not meet the required 1.0 benefit/cost ratio. If the ratio falls below 1.0, the airport can agree to pay up to 20% of the total costs, providing the subsidy directly to the contractor. For example, if an airport achieves a 0.85 ratio, it could agree to pay 15% of the costs with the FAA picking up the remaining 85%. However, *both contract towers and cost-share towers have been the subject of an FAA-imposed moratorium since FY 2014, and it is now FAA policy that an airport cannot originally enter the contract tower program as a cost-share participant* (see section 2.2).

Non-Federal Towers *(n=total unknown)* encompass a relatively small number of independent towers owned by state and local governments and operated by public employees or private contractors. Examples include New York's Schenectady County Airport, Florida's Merritt-Titusville Airport and California's Moffett Field. Airports with non-federal towers generally do receive federal capital or operating funds and operate under recommended procedures of the FAA.[8]

[8] See *Operating Procedures for Air Traffic Control Towers (ATCT) that are not Operated by, or Under Contract with, the United States (Non-Federal)*, AC 90-93B.

1.2 Budgeting, FAA Funding and the 2013 Sequester

The White House and Congress, and the Democratic and Republican parties, have tussled over fiscal policy during the last several years. Often this has resulted from disputes over spending priorities, the levels of annual budget deficits, and decisions to raise the national debt's statutory ceiling. Aviation and air traffic control policy generally have not been subject to these disputes. However, because the FAA operates and, via annual appropriations, funds air traffic control, when budget politics forces spending to be reduced, halted or provided in short-term installments, the FAA and often aviation system users feel the effects almost immediately.

The FAA's vulnerability to budgetary train wrecks and political disputes became all too real in early in 2013 when policymakers failed to agree on $1.5 trillion in spending cuts mandated by the Budget Control Act of 2011 (BCA). Reductions had to be made by December 2012 to prevent triggering across-the-board spending cuts. The BCA was designed to make reductions draconian to force policymakers to agree on spending cuts to avoid triggering "sequestration."

When politics failed, the BCA's sequestration process mandated specific cuts, especially on domestic discretionary programs (understood as priorities of Democrats) and defense programs (understood as priorities of Republicans). Cuts of $26.1 billion or 5.1% in discretionary spending were ordered. Since by that time it was already halfway through FY 2013, and many agency contracts were nearly impossible to break, disproportionate cuts would have to be absorbed by the remaining programs. For the FAA, these reductions translated to $636 million in cuts between April and September 30, 2013.

To fund these reductions, the FAA furloughed 47,000 of its employees for one day per each two-week pay period, eliminated overnight controller shifts at 60 air traffic control facilities, froze hiring of new controllers, and closed the FAA Academy that trains new controllers (the Academy would ultimately remain closed until December 2013). The FAA also declared itself unable to maintain air traffic equipment, such as navigation aids, at all but the largest airports. Getting most of the attention, however, was the agency's stated intent to close 189 contract towers (later revised to 149).

In its effort to triage the air traffic control system, the FAA saw these "low-activity towers" as lower priority, and closing them as the best route to cost savings. The average activity level for towers on the closure list was 54,000 annual operations, placing contract towers such as Spokane's Felts Field (with 52,000 annual operations) just below the cut line. The 40 airports the agency decided to save from closure met one or more criteria the FAA determined were in the national interest. While tower closures would not prevent commercial and general aviation traffic from arriving and departing at an airport (that traffic may be controlled by a regional facility), they would rely more heavily on pilot-to-pilot communications, thereby increasing the work of the regional air traffic control center and slowing arrivals and departures at the local airport.

After intense lobbying by contract tower advocates and members of Congress, the FAA postponed tower closures until June 15, 2013, but implemented the controller furloughs beginning on April 21. For many air traffic control towers in complicated airspace, the loss of one or two controllers had a significant impact on managing the volume of air traffic.

These FAA spending reductions were painful and public, and immediately affected air traffic. At a meeting of the FAA Management Advisory Council (MAC), FAA Administrator Michael Huerta informed the executive director of Los Angeles World Airports, Gina Marie Lindsey, that arrivals into Los Angeles International Airport would be reduced by nearly a third because of the furloughs. Nationwide, the staff reductions caused 3–4% of flights to be delayed in busy metropolitan areas such as Los Angeles, New York, Dallas-Fort Worth and Chicago, with growing concern about the effects of prolonged furloughs, and later tower closures, on travel and the economy, airlines, and related business activity.[9] Faced with the uproar, Congress less than a week later authorized the FAA to end the furloughs and rescind the tower closures by permitting it to transfer $253 million in funding from the AIP capital account to the FAA Operations account.

The episode highlighted how uniquely vulnerable the air traffic system is to interruptions of government funding. While highways and transit receive federal grants, and delays in that funding may burden state and local agencies, the U.S. government does not operate their systems, so they remain fully functioning during these types of political failures. The FAA, by contrast, *operates* the ATC system, meaning any interruption of government funding causes immediate impacts to its services and the larger aviation industry.

9 See *Sequestration at the Federal Aviation Administration (FAA): Air Traffic Controller Furloughs and Congressional Response*, Congressional Research Service, May 7, 2013.

After the full effects of sequestration were averted, the FAA MAC, joined by the Business Roundtable, and later the Eno Center for Transportation, all made recommendations addressing the unique vulnerability created by FAA operation of air traffic control in an era of budget scarcity and dysfunction. Each organization called for decoupling the provision of air traffic services from the federal budget. Each also recommended a new organizational model that would separate the current Air Traffic Organization from the FAA. Ultimately, these recommendations formed the basis of Chairman Shuster's legislation.

1.3 Continuing Traffic and Operations Challenges

The FAA's 2014 moratorium on new contract and cost-share towers followed the aftermath of the 2013 sequestration debacle, and a prolonged recession in general aviation and commercial service reductions at many of the nation's smaller airports. The decade hit general aviation especially hard. During the 2008–2009 recession, domestic general aviation aircraft manufacturing dropped 48.5%; this plunge compounded reductions in flying caused by years of escalating fuel prices, which had priced many pilots out of their cockpits. While fuel prices have since dropped significantly, and general aviation manufacturing has gradually increased, the levels of activity have not returned to the pre-2007 levels and the FAA still predicts just 0.1% growth in the total general aviation fleet over the next 20 years—essentially zero growth.

The recovery of commercial aviation has been much stronger than general aviation as mergers and consolidation, declining fuel prices, and economic growth continue to lay the foundations for strong profitability for U.S. airlines. But the effects on airport growth are uneven, with 72% of enplanements passing through just 30 large hub airports, with the remainder spilling over hundreds of smaller commercial service airports.

These declines in smaller airport service and use will likely reduce to below the 1.0 threshold the benefit/cost ratio of some airports that previously passed FAA criteria for towers. If so, the airports would then need to pay a percentage of controller costs. Three years after the contract tower moratorium began, the FAA is still reviewing the agency's benefit/cost methodology for airports requesting a control tower. In its FY 2017 budget request, the FAA noted that in FY 2016 it would "update and evaluate the costs and benefits of the Federal Contract Tower airports, FAA towered airports, and future airport applicants to the program."[10] The latest estimate is that the FAA hopes to complete this analysis sometime in 2018.[11]

The FAA's moratorium has frustrated many smaller communities that want to apply for the program or elevate their towers from cost-share to full federal contract towers (assuming the 1.0 benefit/cost ratio can be met). Airport executives are also frustrated by the FAA's reluctance to share its methodology for computing the costs and benefits. This means, for example, an airport does not know which benefits the FAA ascribes to the tower, precluding the airport from disputing the FAA's findings. Nineteen non-towered airports have expressed an interest in the contract tower program. Some may benefit from a "remote tower" should they not qualify under the benefit/cost requirements or should they believe a remote tower would be sufficient.[12] (See next section for more on "remote towers.")

From the FAA's perspective, given its years of tight budget constraints, especially for its Facilities and Equipment (F&E) account (which includes construction of air traffic control towers), new contract and cost-share towers may not be a high enough priority. The F&E account also includes many of the programs that constitute NextGen, the agency's effort to modernize the air traffic control system. With sequestration, debt limits, and partial-year appropriations, it has been the FAA's F&E account, with multi-year projects, that has often borne the brunt of budget reductions in the form of delays or cancellations of programs.

In late June 2017, House and Senate draft legislation to reauthorize the FAA and its programs included several provisions related to contract towers that require the FAA to end its moratorium on new contract tower airports, reform the benefit-cost process to include non-FAA benefits and conduct B/C analyses only if traffic dropped significantly, and to increase the amount of Airport Improvement Program capital grants that can be used to fund the building and equipping of a contract tower.

10 See *Budget Estimates 2017*, Federal Aviation Administration, p. 242.

11 Robert Poole telephone interview with FAA's Nan Shellabarger, Feb. 16, 2017.

12 The 19 include: Gulf Shores (AL), Marana Regional Airport (AZ), San Bernardino (CA), Greeley (CO), Deland (FL), Destin (FL), Coweta County (GA), McKinnon/St. Simons Island (GA), Lewis (IL), Hammond (LA), Cape Girardeau (MO), Pascagoula (MS), Richlands (NC), Las Cruces (NM), Boulder City (NV), Columbus Rickenbacker (OH), Chester County (PA), North Texas Regional Airport (TX) and Friday Harbor (WA).

Part 2

The Potential of Remote Towers for Small Airports

2.1 What Is a Remote Tower?

A new concept has entered the world of air traffic control over the past decade: the remote (or virtual) tower. It uses an array of sensing and communication technologies on the airfield and the surrounding airspace, while providing the actual control functions (using certified controllers) in a ground-level facility. That "remote tower center" could be located at the airport in question, or it could be located at a considerable distance. In the case of low-activity airports, it is possible to locate controllers responsible for several small airports in a single remote tower center (RTC).

The remote tower concept decreases the up-front cost and lengthy construction schedule of building a tall physical structure, while also reducing environmental and air navigation impacts. It may also reduce annual operating and maintenance costs, especially in cases where one remote tower center serves several small airports. That means when the benefit/cost ratio for a new contract tower is calculated, the *benefits* likely equal (or exceed) a conventional (physical) tower's, and the *costs are lower*, thereby producing a higher B/C ratio.

The FAA did some initial research on the concept (then called "virtual tower") in the early days of NextGen a decade ago. It used the FAA research center's tower simulator in Atlantic City, NJ, which includes a 360-degree simulated "out-the-window" display and displays of terminal-area and ground traffic. Using experienced controllers, the FAA simulated both conventional tower operations and virtual tower operations, with the latter providing only the data that would be fed to an actual remote tower center. At all hours, but especially at night, the controllers performed better and actually preferred the simulated remote tower. The FAA concluded that the demonstration "indicates that it is feasible to provide ATC services using a [staffed virtual tower] system."[13]

[13] Hannon, Daniel, et al., "Feasibility Evaluation of a Staffed Virtual Tower," *The Journal of Air Traffic Control*, Winter 2008.

Except for control towers, no other ATC facilities (TRACONs and Centers) have windows to view the aircraft they control. They rely entirely on surveillance and communications technology to enable controllers to do their jobs. The remote tower applies the same ideas to the airport control tower function.

2.2 How Do Remote Towers Work?

As with a conventional tower, the controllers in a Remote Tower Center (RTC) must have *surveillance* technologies and *communications* technologies. A conventional tower provides visual surveillance via the controller's out-the-window (OTW) view of the airport surface and local airspace, aided only by binoculars. Larger towers have tower radar displays of traffic in the surrounding terminal airspace. And the largest airport towers also have surface surveillance tower displays.

With a remote tower, surveillance is generally provided by an array of video cameras, both conventional and infrared, to replace and improve upon the controller's OTW view. A primary camera housing is mounted on a pole of suitable height, with an array of cameras to provide a 360-degree field of view. Some cameras are equipped with pan/tilt/zoom (PTZ) capability. Additional cameras might be needed at other airport locations to cover any visibility gaps from the pole-mounted camera array. At larger airports, surveillance of the *surface area* might be provided by equipping all ground vehicles with ADS-B devices (like those that will be required on aircraft by January 1, 2020). Many uses for remote towers will be at non-radar airports, but when radar surveillance is available, that information will also be provided to controllers in the RTC. Transmitting data from the airport to the RTC will require employing a variety of communication data-compression technologies, and encryption.

Communications between controllers at the RTC and aircraft that use the airport are primarily via radio, supplemented by signal-light guns for use when radio communication with an aircraft is not possible.

As in a conventional tower, all surveillance and communications information is transmitted to one or more controller positions in the RTC. The displays typically include an "out-the-window" display of the airfield, data from radar (if available) and any other surveillance method (such as multilateration or ADS-B). Controls would include microphones, airport lighting controls, PTZ camera controls, etc. Displays may also include weather conditions (such as a wind rose), a compass rose, and geographical overlays. Technology is also available to provide object tracking and alerting (in the air and on the ground) and features such as automatic runway intrusion alerts.

Many of these features go beyond the capabilities of a conventional VFR tower, providing enhanced situational awareness, especially in low-visibility conditions (where infrared cameras offer greatly increased visibility). Microphones relay airfield ambient sounds to the RTC controller. Another feature is video recordings, whose data can be routed to other locations for contingency operations and can be used to support accident investigations.

2.3 Remote Tower Implementation Overseas

Remote towers are rapidly becoming a reality in Europe. On the very large end of the scale, London Heathrow Airport implemented a remote contingency tower in 2009; it provides 70% of normal capacity using a ground surveillance display system, but does not include an "out-the-window" display.

Sweden became the first to deploy tower services from a remote facility, when in April 2015 the nation's ATC company, LFV, took over tower service operations at Örnsköldsvik Airport and switched control for them to Sundsvall, over 150 kilometers away. LFV is the ATC corporation responsible for air navigation services at 23 airports in Sweden. For this venture, LFV partnered with Saab, an aviation technology provider. LFV has since added Sundsvall Timrå, a second airport, and in 2017 is expected to begin controlling operations at Linköping. These are being done as "multiple mode" operations—handling operations at more than one airport from a single RTC. In 2015, prior to their conversion, these three Swedish airports had a total of 25,000 air traffic movements, including 12,000 commercial movements carrying a total of 500,000 commercial passengers.

Remote tower camera housing deployed at the commercially-served Sundsvall-Timrå Airport in Sweden.

Controllers at LFV's Remote Tower Centre at Sundsvall shown providing remote tower services for the Örnsköldsvik and Sundsvall-Timrå Airports

Following Sweden, Norway provides another example where the cost of providing towered services encouraged the ATC provider to look at remote towers as an alternative. Both nations lie entirely north of the continental U.S. and, like Alaska, span northward beyond the Arctic Circle. Accessibility of aviation services is vital, yet relatively expensive given the weather conditions and the limited number of passengers and operations to spread the costs over. In addition, any airport in Sweden or Norway that accepts commercial airline traffic must provide towered, or now remote-towered services. That is a key difference from the United States, where commercial airlines routinely operate at non-towered facilities

The goal for Avinor, a government-owned ATC company under Norway's Ministry of Transport and Communications, was to provide access to Norway's remote airports while reducing costs by 100–150 million NOK ($17M–$23M). Avinor is self-sufficient from ATC fees and airport operations. It provides services for civilian and military aviation in Norway. It uses revenues from the profitable Oslo Airport to subsidize aviation services and airports in other areas of the country.

Remote tower camera housing deployed at the commercially served Ornskoldsvik Airport in Sweden.

After tests in conjunction with the European Research and Development Programme proved successful, in 2015, Avinor partnered with Kongsberg Defense Systems, using camera and radar technologies to operate remote air traffic control services from Bodø, a centralized facility adjoining an existing airport. Avinor serves 46 airports and in 2017 will commission and begin providing remote services at five airports, toward a goal of operating 15 remote towers by 2020. The total capital expenditure budgeted for the remote tower project between 2015 and 2020 was €81.7 million ($87.6 million).[14]

Another pioneer is Germany. ATC corporation DFS will implement an RTC at Leipzig in 2017 to control traffic at Saarbrücken initially and later at Dresden and Erfurt. The Irish Aviation Authority announced in early 2017 that it had completed the world's first operational trial in which multiple airports were controlled from a single RTC. The Center is in Dublin, and the

[14] See Avinor's *Annual and CSR Report 2015*.

remote equipment is located at Cork and Shannon Airports. Other European remote tower projects are under way in Hungary, Italy, Malta, and the Netherlands.

In May 2017, NATS, the air traffic control company serving British aviation, announced that it was replacing its existing air traffic control tower at London City Airport with a remote tower operated more than 80 miles away at Swanwick as part of a large redevelopment program at that airport. London City has over four million annual passengers, and would be by far the biggest airport to employ a remote tower. Instead of a traditional tower, NATS and Saab will use an 80-meter tower on top of a parking garage to provide the line of sight for 14 high-definition and 2 PTZ cameras. Controllers at the Swanwick facility will have the 360-degree view images as well as audio and radar feeds to serve traffic.

SESAR, Europe's equivalent of the FAA's NextGen technology program, oversees some of the remote tower research in Europe. Other remote tower projects are under way in Australia and Dubai.

2.4 U.S. Remote Tower Pilot Projects

As *Aviation Daily* reported in 2016, the FAA "lag[s] behind Europe in testing and approving remote towers in the U.S."[15] The House version of the planned FAA reauthorization bill in 2016 called for the FAA to deploy and oversee remote tower test projects at seven airports, but that provision dropped out when the House and Senate could not agree on a bill and simply extended the previous authorization until September 30, 2017.

Two U.S. pilot projects are under way. One is at the busy general aviation airport of Leesburg, VA and the other at the somewhat larger Northern Colorado Regional Airport in Loveland, 38 miles northwest of Denver. Saab Sensis Corporation and the state of Virginia's SATSLab, Inc. are funding the first trial, and the Colorado Division of Aeronautics is funding the second. The FAA is cooperating with both projects, even though it is not sponsoring or funding them. Neither airport currently has a conventional control tower.

15 Croft, John, "Shuster Bill a Boon for Remote Towers," *Aviation Daily*, Feb. 8, 2016.

Remote tower system under test at Leesburg Executive Airport, Virginia

In Leesburg, Saab Sensis is employing a mobile tower from contract tower firm Robinson Aviation to operate side-by-side with the latest version of its European remote tower (in use in Ireland and Sweden). Passive testing took place in autumn 2016 with active testing scheduled for summer 2017. The project's goals include reducing arrival and departure delays for IFR traffic, providing greater safety margins for VFR traffic, and securing FAA certification for basic VFR tower services provided via a remote tower.

Unlike Leesburg, Loveland until recently had limited scheduled commercial service (offered by Allegiant). In this case, the tested remote tower will include feeds from a radar located 14 miles away; the remote tower will provide 24/7 video surveillance fused with the radar feeds. Five bidders are seeking to provide and operate the technology. After installation of the equipment by the winner, a two-year demonstration will include both passive and active testing. As with Leesburg, FAA controllers will participate in the testing.

Credit: Saab

Remote tower camera housing deployed on the terminal building at the Leesburg Executive Airport, Virginia

Aviation Week's article on Loveland noted that the FAA's role is "markedly different" from that under way in Europe, where ATC corporations have taken the lead in creating and funding pilot projects and working toward certification. The FAA's current approach aims at certifying remote tower vendors that succeed with pilot projects, adding them to a Qualified Vendor List.[16] It is unclear what such certification would mean for airports seeking to implement a remote tower. It is also unclear whether airports could access AIP grants to fund a remote tower, as they may currently do for a conventional tower.

As part of the same June 2017 legislative process with contract towers, policymakers included a pilot program on remote tower programs in both the House and Senate versions of the FAA reauthorization legislation. Provisions in the two chambers' legislation would establish a variety of smaller airports as eligible, including low-activity FAA towers and contract towers. One provision would also encourage at least one pilot to be a remote air traffic center that could operate air traffic at multiple airports, while another encourages the FAA to select multiple vendors to participate in the pilot program.

[16] Croft, John, "Rocky Mountain Remote: Colorado Takes the Next Step in Virtual Towers," *Aviation Week*, March 6–19, 2017.

Part 3

Benefits and Costs of Remote Towers for Small U.S. Airports

3.1 Remote Tower Benefits

Remote towers and their enabling technologies offer several potential benefits to airports. For non-towered airports, adding new surveillance technologies can streamline access, reduce delays, increase safety margins, and create "order out of chaos."

Remote tower technologies offer benefits to existing towered facilities as well. While these are not yet FAA-certified uses of remote tower technologies, they offer the future potential to both save money and enhance performance. High-definition and infrared cameras that can gather imagery in low-light or nighttime conditions, and allow for the digital enhancement of images, offer improved visibility over a controller with an out-the-window view of an airport's environs.

Potential application of these technologies includes allowing airports to use cameras to cover potential blind spots that controllers might be unable to see from a tower. Rather than either eliminating the blind spot (thereby reducing operational flexibility at an airport) or requiring a costly new tower to cover the obstructed sightlines, cameras could augment visibility at low cost for existing controllers working at the airport.

For late night shifts, a centralized remote tower facility could supplement the work of existing controllers at several different airports, potentially enabling several airport tower services to stay open longer hours and provide increased access and safety. For all airports, better imagery (especially important at night and in rain, snow, or fog) would enable increases in security and safety, since unauthorized surface movements or wildlife on an airfield could be more readily identified. Other ATC corporations, such as Nav Canada, are using remote airport technology as a back-up to traditionally provided services, improving airports' resiliency.

3.2 Remote Tower Capital and Operating Cost Savings

For airports unable to afford a traditional or contract tower, remote towers potentially offer a less-expensive alternative. Countries with significant remote regions served by air traffic offer compelling testimony.

In the Norway and Sweden cases identified above, each ATC provider had the incentive to more efficiently deliver air traffic services for its fee-paying customers. Under these models, their total fee revenue must cover their total costs. Given the proportion of remote regions requiring air traffic services in those countries, recovering the full costs of traditionally provided towered services would be prohibitive, either requiring the ATC company to charge so much as to discourage use, or cross-subsidizing remote airport services by hiking fees charged at major airports such as Helsinki or Oslo. Hence, inventing a lower-cost way to provide tower services at remote airports was key to maintaining or providing services in those locations.

By contrast, today's FAA does not charge air traffic fees based on what it costs to provide air traffic services. The U.S. system relies on cross-subsidization in a very different way than the Norwegians. Passengers on airlines flying U.S. routes are taxed to provide support for the air traffic equipment (F&E), airport capital grants (AIP), and FAA air traffic operations. In addition, U.S. general taxpayers provide a subsidy of between 5% and 30%, depending on the budget year, to the FAA's Operations account. In this way, the costs of less-efficient air traffic facilities are hidden. But in our new era of severe cost pressures on the federal budget, even hidden costs can have consequences.

The DOT Inspector General has noted that the variance in operational productivity of FAA towers can result in the least efficient towers using 42–98% more resources per transaction than the most efficient towers, a substantial difference. During the decade examined (2004–2013) operations declined 19%, while the budget for operations increased 0.6%.[17] Unlike their

[17] Office of the Inspector General, *Efficiency of FAA's Air Traffic Control Towers Ranges Widely*, ST 2015-080, U.S. Department of Transportation, August 2015.

Scandinavian counterparts, however, the FAA's ATO model lacks the direct cost-saving incentive that self-sustaining ATC providers such as LFV or Avinor possess.

Small U.S. airports seeking air traffic services provided by controllers today have two options: a fully funded contract tower or a cost-share contract tower. If remote towers were added to the contract tower program, airports that today find it challenging to meet the requirements of the benefit/cost ratio of 1.0 or more for a fully funded or cost-share contract tower would have a more realistic route to obtain locally based air traffic services.

On the capital side, remote towers offer significant savings, especially if multiple airports are connected to an RTC. Estimated capital costs for a single-station remote tower facility are between $1.5 and $2.5 million, less than the recent capital costs of federal contract towers, which range between an estimated $3 million to $7 million.[18]

Many of the operating costs of providing CPCs for a single remote tower workstation would equal those for a federal contract tower, since they both would presumably use contracted CPCs at similar staffing levels. But the operating and maintenance costs for remote tower systems (cameras, communications circuits, etc.) would be lower than that of a conventional tower (HVAC, elevators, etc.). And as previously discussed, significant operating cost savings would be possible by operating a remote tower system in "multiple mode," similar to the Norwegian and Swedish models. With this set-up, CPCs could be trained to operate traffic at multiple airports, aligning staffing levels with the demands of the individual facilities. Not only would this improve the productivity of CPCs and the efficiency of the operations, it would also provide a potentially improved work experience for the individual controller.

But a new FAA program to add remote towers to the contract tower program seems unlikely. While the advantages to the individual airport and FAA are clear (enhancing services, providing cost savings, and making better use of scarce FAA resources), remote towers face the same budgetary pressures that imperil long-term planning at the FAA and have led to the ongoing triage of its resources.

As part of the FAA Operations account, federal contract towers will receive a minimum of $159 million in FY 2018. Lifting the contract tower moratorium would increase the number of airports seeking to participate in the program. But the squeezed FAA budget problem remains

18 Estimates provided by Bill Payne, Program Manager, Colorado Remote Tower Project.

as an obstacle. Any contract tower expansion, including with remote towers, would potentially take away from other portions of the FAA Operations account. Likewise, adding remote towers to the contract tower program would compete with other priorities in the FAA F&E capital budget, notably many NextGen projects.

The Contract Tower Association estimates that, as of early 2017, there are 15–20 potential new applicants to the federal contract tower program, and that six of the 16 current cost-share airports would likely apply to be fully funded contract tower airports (by having achieved the 1.0 required benefit/cost ratio). A fully certified FAA remote tower program would undoubtedly increase demand even more.

The Leesburg pilot project is ongoing and moving forward, with a scheduled completion date sometime in early FY 2018. The Loveland project, currently in the process to select a vendor, hopes to begin testing toward a completion date and certification by September 2018. Assuming successful completion of the pilots, Saab Sensis and the winning provider at Loveland are hoping to receive FAA approval to deploy remote tower systems in the United States, as Saab has in Sweden and Kongsberg has in Norway. Such companies would be included on a Qualified Vendors List, enabling them to offer their services to other airports, likely as part of the Federal Contract Tower program.

Conclusion

Remote towers offer a proven alternative for the provision of air traffic services at low-activity airports. Importantly, proponents of remote towers do not intend to replace staffed towers, but rather to increase the geographic and time-of-day coverage where air traffic control is not currently provided. Remote towers also offer the FAA or ATC provider the ability to recruit controllers to more-attractive assignments.

The Leesburg and Loveland pilot projects currently under way are necessary first steps in bringing this option to U.S. airports. The potential benefits of remote towers and the business case for an expanded contract tower program are significant—whether considering safety, cost efficiencies, productivity of controllers, or benefits to airports and communities.

The political and budgetary calculus for the FAA, however, suggests that an expanded Federal Contract Tower program is unlikely to occur under status-quo budgetary conditions. Following the advice of its NextGen Advisory Committee, the FAA continues to prioritize capital investment (F&E budget) toward a subset of high-value NextGen projects. And the FAA's Operations budget faces pressures of its own, as the FAA continues hiring and training controllers to backfill a large number of retirements that left an unusually low number of CPCs and high demand for extensive overtime at some of the busiest facilities.

In June 2017, advocates for contract towers and remote towers lobbied Congress to include provisions in the House and Senate versions that would push forward these alternatives to traditional FAA-provided air traffic services. While the Senate language included these provisions without recommending overall air traffic control reform, the House incorporated contract towers and remote towers in its effort to revamp air traffic control. The House's aggressive reform agenda is similar to the effort by the FAA Management Advisory Council in 2013, which concluded that the current funding and governance model for air traffic control is broken and needs to be replaced.

Those four principles, agreed to unanimously, were as follows:[19]

1. Create a sustainable financial future for the FAA, specifically by means of a system of dedicated user-based revenues.
2. Separate a new, commercialized Air Traffic Organization (ATO) from the FAA, overseen by a board of users and aviation stakeholders.
3. Assess and codify FAA authorities and programs to simplify FAA's regulatory oversight.
4. Reform the tax structure, eliminating the current mix of aviation taxes and replacing them with transparent fees for services such as air traffic control.

Under this kind of reform, already in operation in dozens of other countries, the reorganized Air Traffic Organization would be entirely separate from the federal budget (though regulated for safety and user charges by the remaining FAA). As with large commercial airports, its stream of user-charge revenues would be bondable. That would permit *financing* large-scale technology upgrades and significant consolidation and replacement of aging ATC facilities, repaying the bondholders over time from the revenues of a more-efficient, less-costly ATC system.

In this changed environment, the revamped Air Traffic Organization would have both the resources and the incentive to embrace the safer and more cost-beneficial use of remote tower technology, not merely for small airports but also for medium and large airports that need to replace their aging conventional towers, or to add tower capability to serve new runways (as Chicago O'Hare and Dallas-Fort Worth airports have done by adding conventional towers).

Such structural reform would encourage any business or self-sustaining non-profit corporation to consider the safety, cost and personnel advantages of remote towers. Unfortunately, given the way air traffic services are delivered by the FAA today, there is not a similar management incentive or imperative to consider such changes. That is likely to come only through congressional direction or, more productively, through comprehensive reform of the way the U.S. governs, manages and operates air traffic services.

[19] "FAA and Aviation Policy Reform: Now Is the Time," FAA Management Advisory Council 2011–2013, January 29, 2014.

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