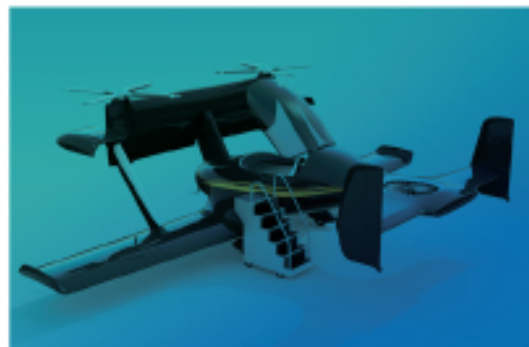
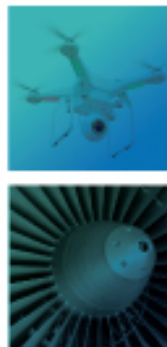


**YOUR VOICE IN  
THE FUTURE OF  
TRANSPORTATION**



# **Creating a 21st Century Air Space Management System**

*July 24, 2017*



## Executive Summary

The global transportation sector is undergoing a transformation as profound and as rapid as the introduction of the internet. It is difficult to predict precisely how mobility – the movement of both people and goods – across various and perhaps new modes of transportation will look in five or even two decades. One thing is certain, economic fortunes will change and even political power may shift as old and new worlds collide and jockey to lead this transformation. Those nations and economies that have access to technology and are agile will ultimately lead the global journey and those that are encumbered by old processes and excess regulation risk getting left behind. No transportation mode will be immune to the disruptive impacts of innovation. This includes and perhaps is especially true of aviation.



The rapid pace of innovation occurring in the aviation sector combined with the critical role the industry plays in the economy of the United States means that managing the National Airspace System (NAS) requires a new approach.

The 21<sup>st</sup> century will see the testing and deployment of air and space launch vehicles that will require transforming our current system of ground based radar and navigation aids to one that leverages space-based position, navigation and timing with advanced on-board avionics, computing, communications and control.

Building a system to safely and efficiently manage what will become a much more crowded and complex sky requires us to think differently. Other nations are already preparing for the safe and efficient management of their airspace in ways that will accommodate existing aircraft but also hypersonic aircraft, drones, space launch vehicles and even flying cars. Some even in the context of an integrated system of moving people and goods over land, sea, air and space.

Our current approach to modernizing the NAS isn't keeping pace with technology or demand. Since 2004, the FAA has been managing the implementation of the Next Generation Air Transportation System (NextGen), a complex, multi-year initiative to replace the current radar-based air transportation system into one that uses satellite navigation, automated aircraft position reporting, and digital communications. NextGen's goals are to increase NAS capacity, enhance safety, and reduce delays.

We conducted this review after reports highlighted FAA'S significant challenges in managing the NextGen program, resulting in significant cost increases, delays, and reductions in promised capabilities without corresponding cost-savings.

The review underscores several systemic issues that FAA has delivering new technologies on time and within budget

These include:

- Overambitious plans
- Unreliable cost and schedule estimates
- Unstable requirements
- Software development problems
- Poorly defined benefits
- Ineffective contract and program management

**The report's findings, detailed below, and recommendations include establishing a stand-alone, not-for-profit corporation to manage the U.S. air traffic control system. FAA would retain its core focus of safety oversight, while the corporation would ensure the NAS, its users, and the general public, benefit from rapidly developing technologies.**

## **Findings**

- **The near future—between now and 2030— will see rapid advances in aerospace unlike anything since the dawn of the jet age.**
- **New technologies and deployments—including drones, hypersonic aircraft, commercial space travel, autonomous passenger and freight transports, and more—require a highly advanced and constantly evolving airspace system.**
- **The U.S.’s longstanding leadership position in global aerospace technology is not sustainable without a modernized airspace system.**
- **FAA’s inability to successfully integrate innovative technology into the NAS is well-documented.**
- **The FAA management culture is not compatible with advances in technology and dooms modernization efforts.**
- **Congressional mandates, reforms and oversight of FAA have not produced intended results.**
- **Absent a fundamental change in the way the U.S. approaches managing and further developing its National Airspace System, its long-established position as a leader in global aviation will be lost.**

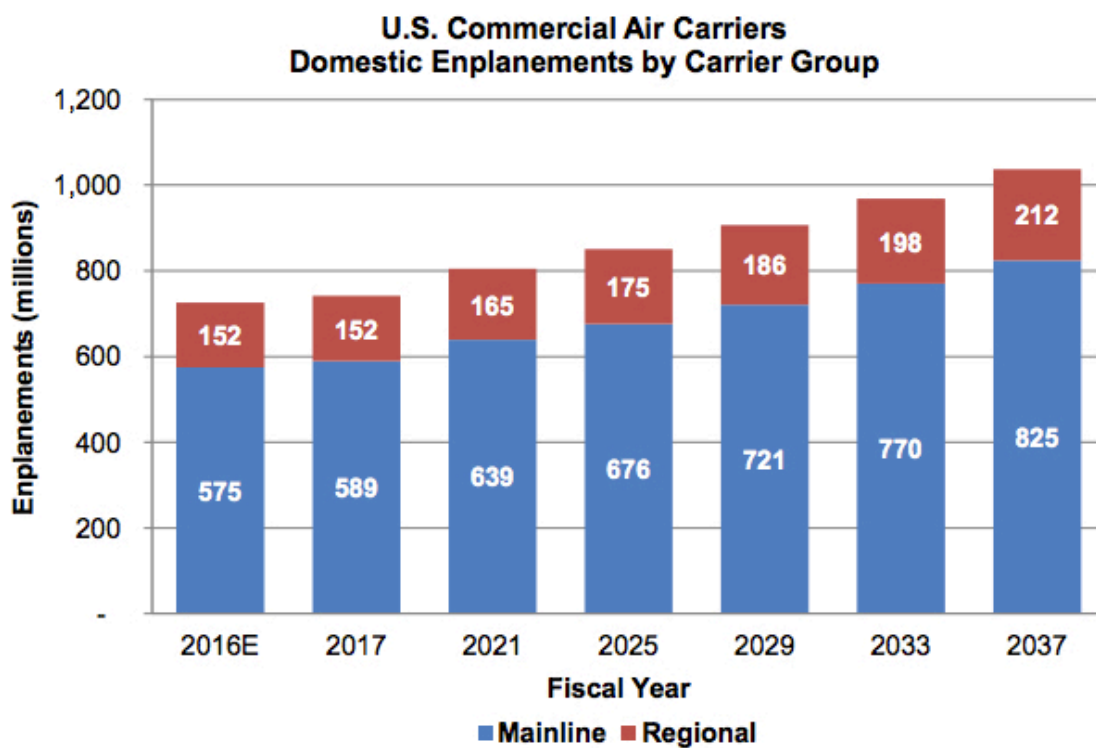
## **The NAS Must Evolve To Meet Demand, Accommodate Innovation**

Since 1958 the FAA has overseen the safe operation of the busiest and most complex air traffic system in the world. The agency has established an impressive safety record, but thanks to a decades-long struggle to keep pace with advances in technology, safety margins are thinner than necessary.

“Every day, passengers rely on the critical performance of FAA computers to track flights and ensure that planes do not collide. If the air traffic control system is unreliable or fails, not only are tax dollars at stake, but also are the lives of our nation’s airline passengers,” then-Senator William S. Cohen (R-

Maine) wrote in 1994. “The FAA has not been able to update its computer systems since the mid-1960s. Air traffic control technology is so old that FAA must search Radio Shack for spare parts and buy vacuum tubes from a manufacturer in Poland to keep the nation’s air traffic control system running.”

Aviation’s growth, like its importance to the global economy, continues unabated. Global passenger demand, as measured in revenue passenger miles flown, has grown an average of 5.5% per year in the last decade. In the first five months of 2017, the figure was 7.7%. Both figures significantly out-pace global GDP, which has hovered around 2.5-3% this decade.



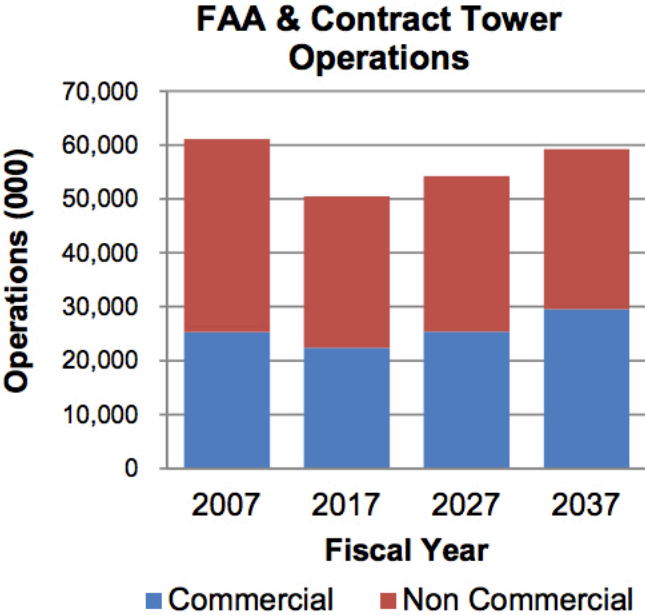
While the U.S. is considered a “mature” market in terms of commercial growth, it has both the world’s largest passenger-aircraft and general aviation fleets—more than 215,000 active aircraft. Annual domestic passenger demand, as measured by enplanements, will increase from less than 800 million in 2016 to nearly 1.2 billion by 2037. Tower operations—or the number of flights that ATC must handle, has declined in recent years, but are forecast to increase by about 20%, to nearly 60 million, by 2036. The advent of unmanned aircraft systems, often called drones, brings even more challenges to already-crowded airspace. On the horizon: personal

transportation—Uber’s Elevate project envisions hybrid-electric, vertical takeoff and landing pods flying in major U.S. cities within five years—and it’s clear that the NAS faces unprecedented challenges meeting demand.

Simply put, aviation—much like the entire transportation sector—faces not only unprecedented demand, but also imminent transformation as increased autonomy fundamentally alters the movement of people and goods over land, sea and air.

Advances in cutting-edge technology, including sensors, computer vision and position, navigation and timing are all building blocks of the transformation that will drive efficiencies in our global transportation system. At the foundation is a corresponding transformation in artificial intelligence, machine learning and computing power. Together, they hold the promise that increasingly smart vehicles, including aircraft, will acquire levels of situational awareness that will, for example, enable planes to ferry passengers at hypersonic speed in seemingly crowded airspace with virtually no risk of colliding with other aircraft regardless of altitude, vector or positioning.

Much of the underlying technology to enable this vision exists today. What does not exist is the system design and plan that will field the necessary advances in air space management for the 21<sup>st</sup> century. This system desperately needs designed with sufficient redundancy to ensure resiliency and reduce system risk. The nodes must have the capacity to avoid the potential of collisions in both connected and disconnected states by leveraging advances in technology that will make the risk of mid-air collisions statistically insignificant.



## FAA's Modernization Challenges Are Well-Documented



While many may consider “ATC modernization” to be synonymous with the decade-long, multi-billion-dollar NextGen effort, this is merely the agency’s most recent attempt at sweeping technological reform. The history of FAA’s modernization efforts includes several false starts, incomplete efforts, and major cost overruns.

FAA’s standard precision landing system in use today, the Instrument Landing System (ILS), began testing in 1929. The first ILS-only landing by a U.S airline took place in 1938. Efforts to replace ILS have been underway for nearly 50 years. NextGen is simply the most recent.

### **Early ‘modernization’ failures**

In the 1970s, FAA, working with the Department of Defense, chose a new technology, the Microwave Landing System (MLS), to replace the ILS by 2010. The MLS’s major advantage: it would make much more efficient use of airspace by allowing aircraft to make curved approaches to runway ends.

FAA’s MLS program ran into problems early. A 1978 report from the General Accounting Office noted “a significant level of uncertainty in the Department of Transportation (DOT) and aviation community regarding the overall

benefits expected from the new system. To date, FAA has not developed a cost/benefit analysis acceptable to the DOT, or a transition plan.”

FAA’s original MLS plan, developed in 1971, envisioned limited production and deployment beginning in 1976. By the 1978 report, the date had slipped to 1981.

Problems persisted. Initial installation dates continued to slide. A 1988 GAO report noted that the agency’s plan, which had grown to 1,250 MLSs at a cost of \$1.6 billion, envisioned initial installations in 1986. “However, because of software problems, installation is 27 months behind schedule.”

Meanwhile, incremental improvements to ILS and the emergence of satellite navigation steadily rendered MLS obsolete. In 1994, FAA determined that the program no longer made sense, and MLS was suspended.

### **Key ATC hardware computer-upgrade program stalls**

FAA’s modernization efforts also included computer hardware—the guts of the ATC system. In 1982, it proposed the Advanced Automation System (AAS), which was to upgrade controller hardware, software, and stations by 1996.

Challenges began almost immediately. A 1986 GAO report concluded that “the current AAS acquisition strategy does not adequately mitigate technical risks and does not provide for suitable operational simulation of the advanced automation features.” GAO also found that “AAS as currently planned, may not be economically justified, adding that “the FAA strategy has unacceptably high risks and may result in significant cost increases, schedule delays, and performance deficiencies.”

In 1993, the program—which had doubled in estimated costs to \$5 billion—was still hemorrhaging. “Major factors contributing to the current schedule and cost problems include significant FAA and the major contractor underestimations of the effort required to develop AAS, FAA failure to provide needed oversight of the contractor's performance, and FAA indecisiveness in resolving some basic requirements issues,” a GAO report found.



An independent evaluation of the FAA's management of the AAS program concluded that:

- The FAA does not have the necessary management and engineering expertise to undertake such a large program
- The management process lacked discipline and authority
- Responsibility was not clearly assigned
- Accountability was absent.

The report found that FAA leadership did not enforce milestones, assess performance or fix individual responsibility. Many of the problems with AAS were raised by support contractors early in the program, but this information was ignored by FAA managers and had a limited distribution.

***Congressionally-Granted Personnel and Procurement Regulations Relief Fails To Improve FAA's Performance***

Despite the findings of culpability at all levels, FAA management laid blame for the modernization-program failures squarely at the feet of cumbersome regulations they needed to follow for acquisition, personnel and financial management. They appealed to Congress for relief. In 1995, lawmakers agreed, instituting a series of management reforms to exempt the FAA from federal acquisition and personnel regulations.

Armed with unprecedented flexibility, FAA's leadership assured lawmakers that they had what they needed to overcome decades of program-development challenges that left billions in cost overruns and a still-antiquated air traffic control system in its wake.

As the Pentagon was making advancing and deploying space-based position navigation and timing capabilities throughout the 1990's, FAA's development programs began to emphasize the use of satellite technology for improvements in communication, navigation and airspace management. Congress continued to enact legislation designed to make FAA a performance-based organization and while the FAA has implemented provisions of these reforms, they have failed to achieve promised cost savings or operational efficiencies.

In fact, according to the DoT Inspector General, since the reforms have been enacted, costs have increased while operational productivity has declined. The IG cited that between 1996 and 2012 FAA budget grew by 95 percent with personnel costs increasing some 98 percent. Meanwhile, the number of aircraft operations at towered airports has declined—FAA's figures show that towered operations are down 18% in the last decade (from FY2007 to FY2016), but are expected to rise sharply in the coming years.

After a series of congressional hearings in the 1990s outlining FAA's failures to successfully modernize the ATC, FAA leadership and the National Performance Review undertaken by the Clinton Administration cited burdensome and cumbersome law regulation and policy governing people, acquisition and accounting as the reasons for the failure.

**FAA Continually Demonstrates It Lacks Management Culture Needed To To Implement Major, Necessary Technological Changes**



FAA was adamant that AAS's failure was in large part due to an inability to recruit and retain the engineering, technical and program management talent required to ensure success. In short, the agency did not have the personnel with the knowledge, skills and abilities to manage a large-scale modernization effort.

Its solution? Congressional relief from federal personnel laws and enabling the Agency to implement a new personnel system with the flexibility to hire, train, compensate and assign personnel – as well as negotiate pay and benefits with its collective bargaining units would produce desired outcomes.

The FAA quickly implemented its version of a performance-based pay system and has negotiated five collective bargaining agreements with the National Air Traffic Controllers Association (NATCA). Yet it has failed to develop an agile and strategically oriented personnel and skills management system that aligns people to achieving strategic outcomes.

The FAA's personnel system is held captive to a government management culture that defaults to antiquated, overly cumbersome personnel management practices that are common to large government agencies.

The FAA and the government-wide National Performance Review, enacted in 1993 to reform government processes, also faulted the federal acquisition system for the Agency's failure to meet the cost, schedule and performance goals of the agency's ATC modernization efforts. The 1996 FAA reform package granted FAA an exemption from law, regulation, policy and practices, and required that the agency establish its own Acquisition Management System (AMS) to meet its unique needs.

The AMS was specifically designed to be much less prescriptive and flexible than the Federal Acquisition Regulation (FAR) and allow the agency procurement and contracting professionals to exercise judgement and more discretion. However, the AMS was designed by procurement and contracting officials who were trained in navigating the existing federal procurement processes and practices. Consequently, the culture of valuing execution of the process over ensuring the ability to develop and deliver strategic operational outcomes was prevalent. Moreover, despite the exemption from the FAR, the agency remains expected to meet whatever guidance it receives from budget examiners and other executives, including the Office of the Federal Chief Information Officer and Office of Federal Procurement Policy and Office of Information and Regulatory Affairs.

Congressionally driven organizational reforms have not been embraced by FAA management, and there is little reason to believe that this will change. For example, in 1996, Congress required the FAA to establish a cost accounting system and in 2000 called on the Agency to appoint a Chief Operating Officer (COO) to oversee the daily operation and modernization of the ATC system. Also in 2000, an Executive Order created the Air Traffic Organization within FAA.

It took the FAA a decade to implement the cost-accounting system, three years to hire a COO and four years to establish the ATO. When problems in the NextGen program cropped up, this key initiative—the very foundation of the ATO and its operational function—was moved out of the organization and placed under an assistant administrator, ostensibly to increase visibility into the program after it was clearly not meeting expectations.

## Conclusion and Recommendations



The safe and efficient management of the U.S. National Airspace System (NAS) is critically important to the country's economic health and well-being. It is also will play a key role in supporting aviation's growth as well as new technologies being envisioned that will change the way people and goods are moved, both within cities and between continents.

Over the past twenty years, Congress has enacted legislation specifically aimed at making FAA more efficient and cost effective while expediting modernization projects – despite Congresses best efforts – it has had the opposite effect – the budget has doubled and with no improvements in productivity and significant challenges in meeting modernization targets.

Congress has provided the Agency with significant support to modernize the NAS – most notably through its backing of the Next Generation Air Transportation System (NextGen), a multibillion-dollar transportation infrastructure project intended to make flying safer and more efficient.

FAA's NAS management practices have established a clear pattern of major initiatives that fall short of expectations and reform that either comes too late, or not at all. Its lack of forward-thinking initiatives and agility mean that large-scale programs under its direction, such as MLS and AAS, are de facto doomed from the start, resigned to be too slow, too late, or too poorly managed to deliver the projected value.

Advances in technology including artificial intelligence and machine learning; space-based position, navigation and timing; advanced communications; and ground, air and space-based sensors can enable dramatic improvements to our ability to manage the NAS. Yet FAA's longstanding and well documented management problems have resulted in tens of billions of dollars being spent with only marginal improvement to the NAS.

The organizational and management culture of FAA is resistant to change. The conditions that persisted at the time of the earlier failures to effectively deliver new technologies and capabilities remain rigidly in place today. The FAA has failed to capitalize on the relief from antiquated and cumbersome processes the federal government's procurement and hiring processes and it is the flying public—and innovative companies that see more potential benefits operating in the NAS— who are paying the price.

Continued reliance on FAA to modernize and effectively manage the NAS risks seeing the U.S. fall farther behind, costing aviation companies more money in delays and inefficiency, and hampering technological advancements that will spur new businesses and economic growth.

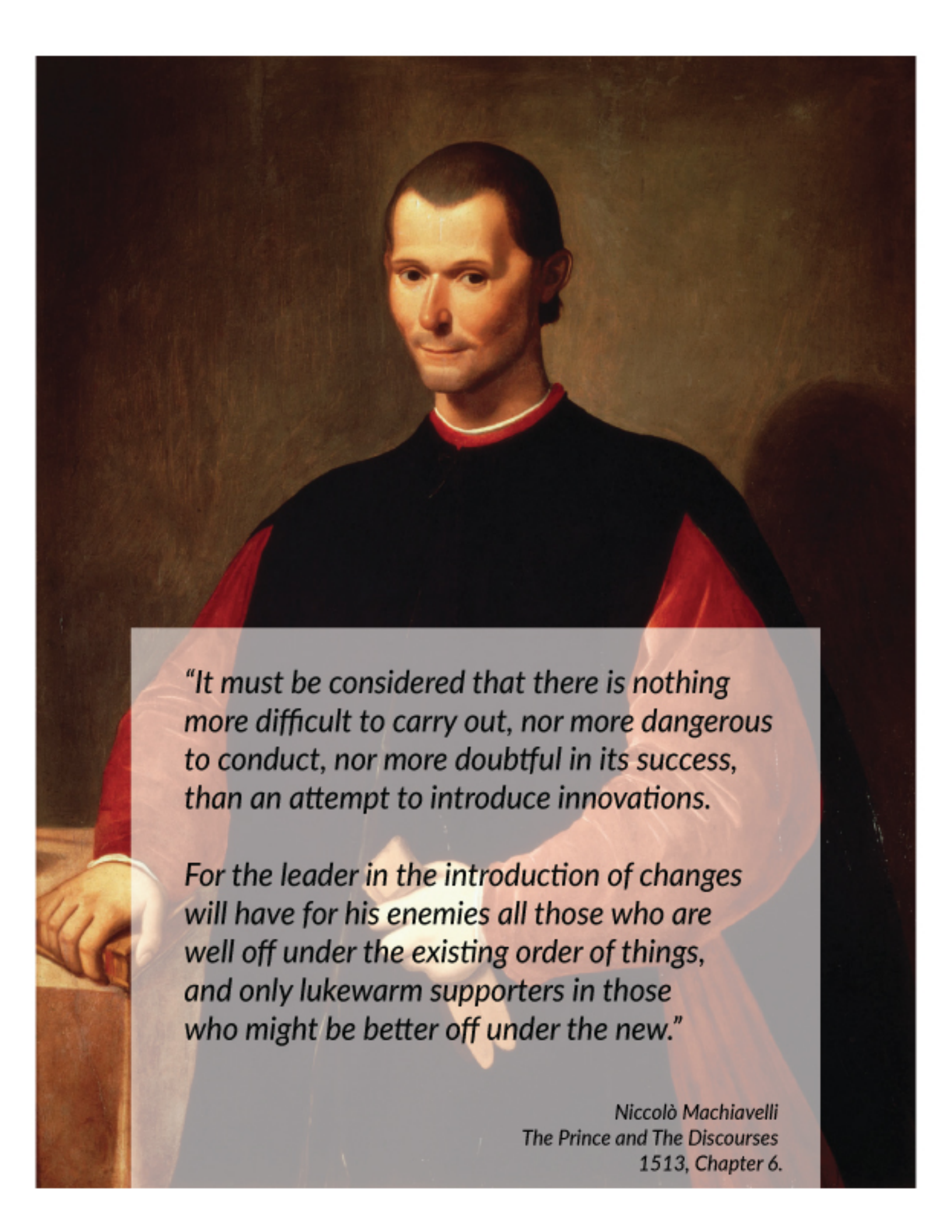
**A decisive act by Congress and the Executive Branch is needed to ensure our nation's air traffic control infrastructure keeps pace with the needs of those it serves, today and in the future.**

### **Recommendations:**

- 1) Congress should enact legislation to establish a Federally chartered, not for profit corporation charged with operating and modernizing the management of the national airspace.
- 2) Congress should establish a board for the corporation. One is a requirements board that represents NAS users, including (but not limited to) commercial airlines, the general aviation community, airports, commercial space, the Department of Transportation, the Department of Defense, and NASA. Board members should serve staggered, five-year terms.
- 3) The board will recruit and hire the management team for the corporation with candidates coming from relevant backgrounds. After a

period of one year the CEO will be an ex-officio member of the board of directors.

- 4) The board should appoint an advisory committee of current and retired executives from organizations with experience in executing complex technology intensive programs across relevant sectors with representation from leading communication, technology and engineering firms and ensure that functional expertise in financial management, auditing, purchasing, human capital management are all represented.
- 5) The functional and administrative processes and polices including financial, accounting, auditing, purchasing, contracting, personnel, information technology, and communications should be established in advance of transitioning functions and personnel. The processes and systems that will be established should be based on proven industry practices. Integration and transition activities should be managed with the support of firm(s) with expertise and references from large complex organizations who have successfully integrated equally large and complex organizations.
- 6) The corporation should develop a detailed transition plan to include the training and integration of existing FAA employees as well as ensuring the ability to quickly hire those with critical skills.
- 7) Existing and operational support contracts and contractors should be assessed and amended to support the new corporations program, operational, financial management, audit, measurement or other management processes and practices.
- 8) Exact date of transitioning operations from FAA to the Corporation will be determined in the transition plan that should be presented to the Committee no later than one year after enactment of this legislation.
- 9) The Committee should authorize the necessary funds to establish this Corporation.

A portrait of Niccolò Machiavelli, a man with a shaved head and a small tuft of hair, wearing a black tunic with red sleeves and a white collar. He is looking slightly to the left of the viewer. The background is a dark, textured brown.

*"It must be considered that there is nothing more difficult to carry out, nor more dangerous to conduct, nor more doubtful in its success, than an attempt to introduce innovations.*

*For the leader in the introduction of changes will have for his enemies all those who are well off under the existing order of things, and only lukewarm supporters in those who might be better off under the new."*

Niccolò Machiavelli  
The Prince and The Discourses  
1513, Chapter 6.