Aviation 2.0 — Explained

A new operating standard for preventing congestion at commercial airports

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1. Executive Summary

Exhaustless Inc. is establishing congestion-free flight service with the Aviation 2.0 Operating Standard (A2OS) to provide reliable schedules at high-demand airports.

A2OS bundles patented and patent-pending innovations to insert the Exhaustless Inc. ('our' and 'we') third-party Aviation 2.0 Congestion Prevention Service (A2CPS) that relieves chronic flight-congestion by preventing the over-scheduling of flights. We reduce flight volumes to congestion-free levels, then concurrently introduce market-based mechanisms to allocate supply and demand within those levels. We allocate the congestion-free airport capacity to carriers through bi-annual slot auctions and meter that volume to passengers and freight carriers with congestion-prevention premiums. These changes create and maximize new competitive market-forces that will lead to improved passenger experience and a more profitable industry.

A2CPS further deregulates the industry by enabling competitive markets to deliver congestion-free service, thus 'placing 'maximum reliance on competitive market forces and on actual and potential competition' as prescribed in the Airline Deregulation Act. This completes the move of 'setting service' to the private sector, discontinuing the activity of regulators in setting acceptable delays, and so requires a new operating standard for the participating airports and airlines.

A2OS maneuvers the industry through legal, economic, and technological hurdles to convert some of the more than $40 Billion of annual congestion-delay losses to new industry profit. Significant new profit-potential for airlines and airports — from reduced congestion-delay costs — incentivizes them to license A2OS. The improved industry cost structure will attract the investment in innovations needed to overcome flight volume limitations in crowded cities. Our method of approach is cooperative, but with urgency. Security risks, health impacts, and economic losses from congestion-delays harm the industry and the nation.

Exhaustless will conduct a one-year market trial of A2OS in New York City beginning with the Winter 2018 season.

Exhaustless will coordinate the rapid and cooperative migration at congested airports to the new standard of congestion-free flights — the future of aviation.

2. The Aviation Experience Today

Aviation passengers today pay to upgrade their service in many ways. They pay for larger seats and better food service in business class. They pay for nicer, quieter lounges while they wait at the airport, for expedited security screening, for priority boarding. Yet they are unable to pay to affect the two fundamental aspects of service quality – the time required for travel and the reliability of the schedule.

Airlines are also unable to affect the time required for travel and the reliability of the schedule. That is because, at the busiest airports, peak-time flight volumes are too high and often lead to chronic congestion. As chronic congestion-delay costs from the idling flight crew and aircraft grow, margins on passenger seats shrink. To maintain profitability, airlines focus on marginal revenue from higher numbers of smaller seats with added à la carte pricing and baggage fees. Since airlines cannot affect service quality, they compete on what they can affect — price. Those cheap airfares come with a hidden, ever-increasing cost to passengers — and shareholders — in schedule-uncertainty and increased travel time from congestion delays.

And because the law prohibits regulators from setting price or service, they can only seek a compromise between runway gridlock and carrier monopoly through rulemaking. There has been no progress on the big problem of reducing the congestion that causes delays. And there are no other solutions on the horizon; neither NextGen, privatizing air traffic control, nor day-of-travel flow management address chronic delays from over-scheduling.

The industry's quasi-regulated environment coupled with today's profitability — suppressed from delay costs — deter both external and internal investment in aviation throughput. This frustrates passengers, airlines, and Congress, and has resulted in misplaced blame and increasing stress surrounding air travel.

The industry is stuck.

Aviation 2.0 helps the industry move forward to an era where timely takeoffs are the norm — with no chronic congestion-delays — and where passengers continually fund innovators to improve the industry. Fair, open, and transparent competition among passengers and among airlines aligns with the spirit and letter of the Airline Deregulation Act to restore schedule certainty and profitability to air travel.

3. Impacts of Congestion

Congestion is physical competition between two or more objects attempting to occupy the same space at the same time. The presence of chronic congestion is a sign that competitive market forces are not at work — a competitive market would increase prices until there is no congestion, which would provide the funds to increase capacity enough to serve the excess demand.

Chronic congestion-delays increase travel time and reduce the reliability of travel schedules. Reducing these delays has been a matter of importance to the aviation industry and to Congress for many decades.

Chronic flight-congestion is a critical problem that causes covert economic and health costs, and serious security risks.

a. Delay costs of congestion

In 2010, NEXTOR[1] released their Total Delay Impact Study (TDIS). The researchers modeled air traffic network delays by looking at statistical utilization of congested airports - where flight operations are over-scheduled and don't have enough buffer to handle random fluctuations, leading to flight cancellations and delays. Their estimate for the **annual** cost of delays, in 2017 dollars, was **$40B**; $20B incurred by passengers, $10B by airlines, $5B in lost tourism, and $5B in lost GDP. This cost estimate was based on time-value, not market-value —it is currently unknown how much airlines and passengers are willing to pay to avoid delays.

To put this amount of costs in perspective, the annual cost to airlines was *equal to* the industry's domestic free cash flow for 2016.

b. Health costs of congestion

In 2014, researchers at UC Berkeley[2] published a study to determine if airport pollution causes respiratory illnesses. Their findings show the very real losses suffered by families

[1] http://www.isr.umd.edu/NEXTOR/pubs/TDI_Report_Final_10_18_10_V3.pdf
[2] http://faculty.haas.berkeley.edu/rwalker/research/SchlenkerWalker_Airports_2014.pdf

downwind from aviation congestion. The findings estimate that congestion leads to $5B in annual health care cost for families in California alone.[3]

Recent studies have shown that exposure to aircraft noise affects heart attacks, high blood pressure, strokes, and learning difficulties in children.[4]

c. Security risks of congestion

ADSE-X7 time-lapse videos[5] of LaGuardia show a spatial aspect to the congestion, which helps visualize the excessive risk created by crowding aircraft — full of fuel and people — in takeoff queues on the tarmac. The danger to takeoff lines stems from their easy targeting by assailants with standard weapons – especially for airports nestled among neighborhoods, like LaGuardia. The economic impact of this risk — which would be second to the human impact — dwarfs the other categories due to the 5% of GDP linked to commercial aviation.

4. Aviation 2.0 Operating Standard

Exhaustless Inc. is establishing congestion-free flight service with the Aviation 2.0 Operating Standard (A2OS) to provide reliable schedules at high-demand airports. A2OS encompasses the Aviation 2.0 Congestion-Prevention Service (A2CPS) and all other Exhaustless technologies as they become available.

A2OS bridges legal and market gaps in commercial aviation. A2CPS will set flight volumes to congestion-free levels, then concurrently introduce market-based mechanisms to allocate supply and demand within those levels. These changes create and maximize new competitive market-forces that will lead to improved passenger experience and a more profitable industry.

a. Congestion-Prevention Service

Exhaustless' patent-pending[6] A2CPS prevents congestion by limiting passenger and freight carrier reservations to the congestion-free capacity of the airport. The on-time service

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3 The findings estimate that congestion leads to $500M in annual health care cost for California families, but experts in drug development acknowledge that due to the limited Medicare data on the subject the true market numbers are typically 10x higher than the hospitalization data used.

4 http://www.independent.co.uk/life-style/health-and-families/features/how-noise-pollution-can-affect-your-health-a6853746.html

5 https://www.youtube.com/watch?v=O2dg1750aXk

6 System and Method for Managing Air Traffic Data: U.S. Patent Application 15/789,585; International PCT patent has entered the national stage.

prioritizes scheduled reservations, enabling airports to improve customer service to carriers and passengers. Airports and airlines that license A2OS may employ A2CPS.

On the supply side, we facilitate a market where airlines compete for the congestion-free flight-authorizations for each airport via periodic auctions among FAA-licensed carriers. On the demand side, we facilitate a market in which passengers and freight carriers compete by paying a premium to fly at times when market demand exceeds the congestion-free volume of scheduled flights. The premiums will vary in response to changes in excess passenger demand relative to congestion-free capacity.

Passengers will drive the industry away from a maximum-utilization model and toward a minimum-congestion, maximum-throughput model. A2CPS should reduce the peak-utilization level of congested airspaces to improve schedule recovery and resilience of the system to weather and other unplanned events.

Airlines will meet the passenger needs of reliable flight schedules, and price certainty and transparency — without the hidden cost of delays.

After a one-year market trial in NYC, Exhaustless will roll out A2CPS to other airspaces.

1) Supply Management: Flight Volume

There are three steps to managing the volume of flights at high-demand airports to prevent excess supply and reduce chronic delays from over-scheduling service:

a) Measure the congestion-free capacity: New Flight-Authorizations

Exhaustless measures the congestion-free capacity of the airport, as described in the patent application, creating a new kind of slot. Current methods used by the DOT and GAO to determine airport slot-limits rely on modeled averages of airport capacity. This overstates capacity during certain runway configurations, leading to excessive delays.

Prior to each auction, Exhaustless will calibrate the volume of congestion-free flight-authorizations based on analysis of the airport operating data and changes to capacity.

To make the new congestion-free slots available, the DOT will retire the existing flight-authorizations for that airport. The new congestion-free flight-authorizations have a 6-month term.

b) Allocate the congestion-free capacity: Competitive Auctions

Exhaustless will conduct ascending-bid auctions every 6 months to allocate the new congestion-free flight-authorizations. All FAA-licensed carriers are eligible participants. The auction proceeds will be revenue to Exhaustless.

The first auction will be for the three airports in the NYC airspace. All information about the auction, including the timeline and the rules and procedures, is available at www.airportslotauction.com.

c) Prioritize the congestion-free capacity: New Operating Procedures

New operating procedures are necessary to prioritize the on-time service of the congestion-free flight-authorizations. This will be a completely different mindset from the current priority of maximizing utilization and will require training. These procedures establish a congestion-preventive mode of operating the airspace.

The new procedures at participating airports are:

- The DOT will transfer the management of service (slot volumes), for congestion-prevention purposes, to Exhaustless.
- The DOT will withdraw slot limit orders, including the use-or-lose policy.
- The FAA will discontinue the automated processes in place that maximize utilization, such as Adaptive Compression.
- Unscheduled flights may not interfere with scheduled flights. Once airport operations validate the calibration of the congestion-free capacity, the market will need to develop secondary slot markets to allocate any excess capacity from specific operating conditions.

The Aviation 2.0 Licensing Agreement delineates these changes to airport operating procedures.

2) Demand Management: Congestion-Prevention Premium

A2CPS prevents excess demand by charging passengers a dedicated Congestion-Prevention Premium (CPP) on the airfare when they reserve their flight. The premium increases as excess demand increases — driving more demand to off-peak hours. We expect that most of the flights at most of the airports will have no premium because those airports do not experience volume-related delays. Freight carriers will pay the CPP corresponding to the aircraft weight and flight time, as determined by excess passenger demand. CPP will be revenue to Exhaustless.

Patent-pending software[7] extends the existing airfare publication system. It calculates the market-based premium by incorporating delay models into a dynamic pricing-process. Initial values are set using elasticity. An algorithm increases or decreases the premium to maintain rates of ticket sales to within expected ranges — and thereby redirects excess demand to off-peak-time flights.

Spreading the passenger demand to fit the new flight volume will allow the maximum utilization of the airport's aggregate congestion-free capacity[8]. Passengers will have the choice to pay a premium to travel during peak-times — with no congestion delays, or to fly at off-peak times with a lower premium — also with no congestion delays. As off-peak demand increases, carriers will find it more profitable to compete for those customers.

d. Innovative technologies that increase capacity

Exhaustless has patented two technologies that increase throughput in congested airspaces with today's fleet — by reducing wake intensity and runway occupancy. They also generate less noise and air pollution while separating takeoffs and landings.

To understand wakes, go back to the fundamental property of flight, which is that lift for flight comes from wings accelerating air downwards. There are two ways to accelerate air downwards:

- ***Slowly*** accelerate a ***large*** mass of air: *Slow* departure flight speed creates a large, slow-moving mass of air which makes for slower dissipating wakes that restrict departure rate and airport capacity.

- ***Quickly*** accelerate a ***smaller*** mass of air: *Quick* departure flight speed creates a small, fast-moving mass of air which makes for faster dissipating wakes, which is key to higher departure throughput and more slots.

Our patents exploit these insights into wake intensity to move the industry forward to an era where improved air transportation meets the needs of passengers, airport employees, and the surrounding communities with increased, sustainable capacity. *Aligning the goals of passengers with the local airport communities will drive innovation instead of mitigation.*

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[7] System and Method for Managing Air Traffic Data: U.S. Patent Application 15/789,585

[8] Spreading the passenger demand will also reduce congestion and maximize utilization of the entirety of the airport's infrastructure and the supporting transportation infrastructure provided by cities.

1) Patented Takeoff System

Grid-powered propulsion increases the takeoff acceleration rate and velocity of today's unmodified aircraft to increase departure throughput *while reducing noise*. Higher takeoff velocities reduce departure wake intensity — and the time required between airplanes. Flights spend less time accelerating, climbing, and waiting for interfering wakes to dissipate.

Uncoupling the takeoff energy from onboard the aircraft to the grid reduces jet fuel used in takeoff and climb by 43%, or in the average total flight by 6%. This enables growth of the aviation industry in urban environments without building new airports.

2) Patented Thrust Recovery System

Compressed air stored during descent allows for reduced-throttle landings that shrink wake intensity and expedite reverse-thrust recovery after touchdown to reduce runway occupancy and increase landing throughput *while reducing noise*. Flights spend less time waiting between wakes, and less time slowing down on the runway.

5. Impacts to the Industry and its Investors

A2CPS creates significant new profit-potential for airlines[9] and airports from reduced delay-costs[10]. The improved quality of earnings for airlines will lead to increased stock prices and lower costs of capital, increasing the airlines market capitalization[11] an estimated 33% to 203% (or $47 to $285 Billion). See Figure 1 below.

Figure 1 Potential Market Capitalization of Airlines with Congestion-free Operations (in USD Billions)

The improved economics of the industry will attract the investment in innovations to overcome flight volume limitations in large cities. New investments continue the migration to a self-sustaining, self-innovating, and more competitive industry. Passengers benefit from this increased competition; with no delay costs, airline profits will depend on service quality. Airlines will be able to offer better choices of flights to customize service to their target markets.

A2OS further deregulates the industry by relying on competitive markets to deliver congestion-free service, rather than relying on regulators to balance market forces between delays, new entrants, and monopoly airlines. Airlines have been reluctant to exchange their

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[9] See Appendix A: New Earnings Potential for U.S. Airlines Domestic Operations.

[10] Reduced delays will also increase the tourism industry, which NEXTOR estimates loses $5B annually.

[11] See Appendix B: Potential Added Market Capitalization for U.S. Airlines.

grandfathered slots in the past because the DOT could not reduce congestion. Our approach leverages the new profit-potential to motivate airlines and airports to license A2OS.

Two favorable factors contribute to a quick industry transition. First, the innovation for A2CPS consists of offsite software, it does not require investments from airports. And second, only 12 to 15 congested domestic airports[12] need to transition to A2OS to relieve most of the congestion-delays. The operations at non-congested airports will not change.

This rapid and cooperative transition — free of court challenges over slot restrictions or airport fees — leads to a more stable and secure industry. Exhaustless will coordinate the migration among airports, airlines, and the airfare-publication system to A2OS, the new standard for congestion-free, delay-free flights — the future of aviation.

6. Historical Perspective

Congressional hearings about flight delays go back over 40 years. Representatives have repeatedly asked the FAA and the GAO how to reduce delays at congested airports. Their answer is "add capacity" because that is the only legal tool they have. But they don't know how to add capacity for airspace-constrained regions using existing technology.

The DOT has no authority to allocate the capacity using competitive markets. Instead, regulators set flight (slot) limits at a few congested airports, but they must be careful not to promote monopolistic conditions that stifle competition. So, to compensate for slot limits that are set too high, they mistakenly maximize slot utilization at the expense of congestion delays[13] and with minimal consumer protections. This maximizes competitive *physical* forces, rather than maximizing competitive *market* forces prescribed by the Airline Deregulation Act.

When demand exceeds capacity in a deregulated industry, the market limits peak-use to prevent congestion-delays. Economists in the DOT, DOJ and the GAO broadly support this technique, when driven by competitive market forces.

Economists and regulators have long understood that excessive flight volumes cause chronic congestion[14], and that a market mechanism to allocate flight capacity, such as a slot auction,

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[12] https://www.faa.gov/airports/planning_capacity/media/FACT3-Airport-Capacity-Needs-in-the-NAS.pdf

[13] LGA average delay has increased from 65 minutes in 2012 to 79 minutes last-twelve-months in 2017.

[14] "… reducing the level of operations, e.g. through tighter slot controls, should have a positive benefit, despite potential fare changes… policies and mechanisms that limit the level of operations at airports should be considered in concert with capacity enhancements to insure effective use of new capacity in order to reduce flight delay and its associated costs." - NEXTOR TDI Report, October 2010

would promote competition[15,16]. But the FAA lacks the statutory authority to collect or distribute proceeds.

As a private, non-carrier company that has developed intellectual property to derive the congestion-free capacity of each airport, we will auction the flight-authorizations and collect any supplier surplus — in slot premiums — as revenue.

Reducing peak-time demand with congestion pricing is also not a new concept. In 2009, the DOT adopted a policy that allowed airports to increase landing fees to airlines during peak-demand times, to encourage them to land at off-peak times. The DOT abandoned the policy when they determined that this would increase airline costs without reducing flights as needed to prevent congestion. Our method reduces flight volumes and then charges passengers peak-demand congestion premiums to encourage them to fly at off-peak times. Our intellectual property calculates market-based congestion-prevention premiums.

Exhaustless' authority to charge and collect congestion premiums derives from Constitutional intellectual property rights coupled with the Airline Deregulation Act — that requires price and service to be set by markets without creating a monopoly airline. A2CPS is in the public interest and solves long-term congestion management, replacing slot management regulations with market-based services.[17]

After examining the historical attempts of the industry to reduce congestion, and the related court rulings, we developed A2OS to work uniquely within the legal framework of the Airline Deregulation Act and anti-trust laws.

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[15] "Straight caps without some mechanism to ensure an efficient allocation of scarce slot resources is economically inefficient … Market-based pricing has been demonstrated time and again as the most effective way to allocate a scarce resource that is in high demand… Pricing can balance demand with available capacity, resulting in less congestion and more reliable schedules." - Statement of D.J. Gribbin, General Counsel, U.S. Department of Transportation before the House Subcommittee on Aviation, Concerning Aviation Congestion Management, June 18, 2008.

[16] "With the clamor rising over airport delays … this paper advocates the use of market mechanisms, specifically slot auctions, to promote efficient usage of airport capacity, reduce airport delays, and, more generally, promote competition." - Antitrust Division, U.S. Department of Justice, Economic Analysis Group Discussion Paper EAG 07-14: Proposal for A Market-Based Solution to Airport Delays, October 2007.

[17] The history of congestion management since deregulation is summarized in the proposed rule titled "Slot Management and Transparency: LaGuardia John F. Kennedy International and Newark Liberty International Airports at https://www.regulations.gov/document?D=FAA-2014-1073-0001; See 'Using its authority under 49 U.S.C. 40103, and pending the development of a long-term solution' under the section 'LaGuardia Airport after AIR-21".

7. New Perspective

Analyzing air transportation from a systems-engineering and economics perspective, we define and frame the problem in a new way, which leads to fresh solutions.

a. This is an ordinary market

Congress devised the Airline Deregulation Act to convert air transportation into an ordinary market, and so it requires innovations to come from the private-sector. A2OS is a market solution that further deregulates the industry.

In an ordinary market, reservations receive highest priority when allocating capacity. And any excess demand leads to increased prices which drive investment in innovation and improvement — not just mitigation.

b. The limited airspace is the bottleneck

The limiting resource at congested airports is not runways and gates[18] — it is the airspace itself.

Commercial aircraft produce enormous wakes during takeoff and landing that must dissipate before the air can support the next airplane. The heavier the airplane, the more intense the wake. Yet, to increase capacity at congested airports, the industry has increased the size and weight of airplanes, and the time required for the larger wakes to dissipate. This has led to increased delays.

A2OS improves the throughput of the airspace by exploiting these insights in wake intensity. But rather than wait to increase capacity, the industry must — with urgency — migrate to a competitive method of allocating existing capacity to reduce congestion-delays and their egregious costs.

c. Airlines are the suppliers

The historical perspective is that airlines are the buyers. But airlines are the suppliers, responding to the service demand of the passengers.

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[18] The court ruling on changes to airport landing fees explains the industry perspective: https://www.faa.gov/airports/airport_compliance/media/uscourtappeals-airports-rates-charges-jul2010.pdf

d. Passengers are the buyers

Because the historical perspective is that the airlines are the buyers, the industry tried to reduce the excess demand with congestion fees to the carriers. But the passengers and freight-carrier consumers are the buyers, so to prevent excess demand we charge them a congestion premium.

With A2OS, Exhaustless gives passengers the market power to shape service quality, like an ordinary market.

e. Aviation needs two types of airports

There are airports that can meet market demand without congestion, and there are airports that cannot. The needs of these two types of airports are different, and the market must differentiate operations to meet both of their needs. The traditional type of airport with passive infrastructure will continue for most airports. Exhaustless allows for a second type of airport, a new Urban Model, which adopts A2OS to provide congestion-free capacity, has active infrastructure, and has new "Class F" high-throughput airspace.

8. The NYC Market Trial

The world hates change, yet it is the only thing that has brought progress.
Charles Kettering

The New York City metropolitan region is the epicenter of chronic flight-congestion for several reasons. First, there are three major airports within 90 square miles. Second, the wakes created during takeoff and landing by current flight technology propagate across this distance, so the airports must coordinate their activity. Also, NYC is the most populous city in the country, the busiest airspace, a major financial center of the world, and on the east coast, so it has the first flights of the day that impact later flights. Reducing delays in NYC will have a significant impact on trade and the national airspace.

Our goal is to help move NYC airports to the top of BTS on-time rankings.

Exhaustless will conduct a one-year market trial of A2OS starting October 28, 2018. The trial will include the three major airports serving New York City; JFK, LaGuardia (LGA), and Newark (EWR). We will test the hypotheses that 1) over-scheduling of flights causes most flight delays and that 2) passengers and airlines are willing to pay competitive premiums to avoid preventable delays. If this is true, the airports will begin to operate at flight volumes closer to delay-free capacity. The trial also serves as a potential solution to long-term congestion for the National Airspace System.

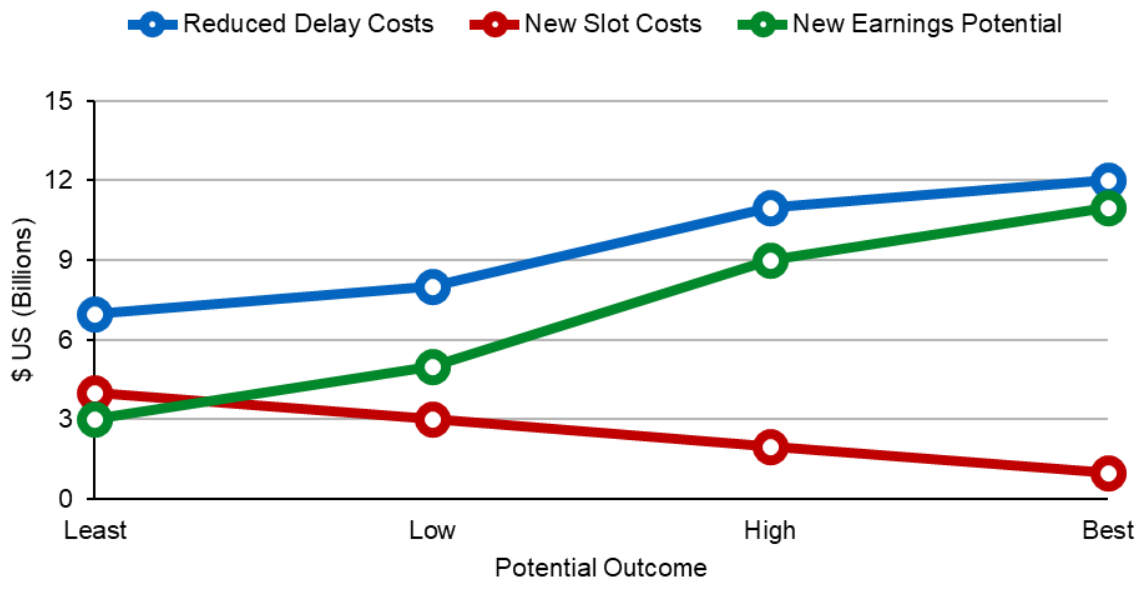
We expect to see at least a 30% reduction in total-delay time by the end of the year, as measured using a combination of Bureau of Transportation Statistics and FAA ASPM data.

9. Appendix A: New Earnings Potential for U.S. Airlines Domestic Operations

From Adoption of Exhaustless' Aviation 2.0 Congestion-Prevention Service
in USD Billions

	Reduced Delay-Costs[1]	New Slot Costs[2]	New Earnings Potential[3]
Least	7	4	3
Low	8	3	5
High	11	2	9
Best	12	1	11

1. The range of airline losses to congestion delays comes from NEXTOR Total Delay Impact Study and FAA updates, in $2017.
2. For comparison, using the bids from the 2011 FAA mini-slot auction, which included no large carriers, would cost $138M per airport.
3. This is based on implementation at 10 airports, but experts estimate that 50-80% come from the three NYC region airports.



10. Appendix B: Potential Added Market Capitalization for U.S. Airlines

From Adoption of Exhaustless' Aviation 2.0 Congestion-Prevention Service
in USD Billions

			Added Market Cap from:			
	New Earnings Potential	**New PE[1] Ratio**	**Lower Delay Cost**	**Increased PE Ratio**	**Combined**	**Increase[2]**
Least	$3	11	$33	$14	$47	**33%**
Low	$5	13	$65	$42	$107	**76%**
High	$9	15	$135	$70	$205	**146%**
Best	$11	17	$187	$98	$285	**203%**

1. Price to Earnings ratio will rise with the congestion-free cost structure and higher quality earnings. The current PE ratio of airlines is at 10.
2. US Domestic Airlines Market Cap $140.3B, Source: New York Times Feb 21, 2018.