



Aviation Megatrends Report 2024

DENterns Discovery Research

Research & Innovation – Denver International Airport



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Executive Summary

Introduction to Megatrends: The aviation industry is undergoing rapid transformation, driven by global megatrends that are reshaping how airports operate and interact with the world. For Denver International Airport (DEN), understanding and responding to megatrends—large-scale, transformative forces shaping the future—is critical for maintaining its competitive edge, enhancing the passenger experience, and ensuring sustainable growth. This report delves into seven key megatrends that will influence the future trajectory of DEN, providing a roadmap for strategic planning and innovation.

Purpose of the Report: The purpose of this report is to equip DEN with a comprehensive understanding of the most impactful megatrends shaping the aviation industry. By analyzing these trends, the report aims to inform DEN's strategic planning and innovation initiatives, ensuring that the airport remains adaptable, resilient, and ahead of industry shifts. The insights provided will support DEN in making informed decisions that align with its long-term goals, such as those outlined in Vision 100 and Operation 2045, while addressing the immediate and future needs of its passengers, employees, stakeholders, and the surrounding community.

Summary of Key Findings:

- **A Changing Workforce:** The rise of remote work, automation, and a growing gig economy are reshaping the aviation workforce. DEN must adapt by upskilling its workforce, fostering flexibility, and creating an inclusive work environment that attracts diverse talent.
- **Customers:** As customer preferences shift, with a growing emphasis on digital experiences and personalized services, DEN must enhance its customer engagement strategies. This includes leveraging data analytics and adopting new technologies to meet the diverse needs of its passengers.
- **Technology Innovations:** Rapid advancements in artificial intelligence, automation, and digital services are transforming airport operations. DEN should invest in smart technologies to improve operational efficiency, enhance the customer experience, and ensure data security.
- **Funding Models:** Traditional funding models are evolving, with a growing need for innovative approaches such as Public-Private Partnerships (P3s) and Energy Performance Contracts (EPCs). DEN should explore new revenue streams and funding mechanisms to support capital projects and sustainability goals.
- **Privatization of Airports:** While full privatization of DEN is unlikely, P3s offer a feasible route to enhance non-core operations. Targeted privatization could drive efficiency and generate new revenue, allowing DEN to focus on its core responsibilities.
- **Sustainability:** DEN is committed to becoming the world's most sustainable airport. However, achieving this goal will require overcoming challenges related to energy infrastructure, Sustainable Aviation Fuel (SAF) adoption, and climate resilience. Partnerships and innovative infrastructure solutions will be crucial.



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- **Urban Population:** The rapid population growth in the Denver region is putting pressure on DEN's infrastructure. To meet increasing demands, DEN must expand its transportation access, modernize its facilities, and prepare for diverse demographic shifts in its passenger base.



Introduction

Overview of Megatrends: Megatrends are powerful, transformative forces that drive significant, long-term changes across industries and societies. In the aviation industry, megatrends such as technological innovations, urban population growth, sustainability, and changes in workforce dynamics are fundamentally reshaping how airports operate and compete. These trends not only influence the immediate operational aspects of airports but also have far-reaching implications for strategic planning, infrastructure development, and customer experience. For Denver International Airport (DEN), understanding and anticipating these megatrends is crucial to maintaining its position as a leader in the aviation industry and ensuring its long-term sustainability and growth.

Context of the Report: This report explores seven key megatrends that are particularly relevant to DEN as it pursues its Vision 100 and Operation 2045 goals. Vision 100 and Operation 2045 are two phases of DEN's strategic plan. Vision 100 is phase one and is focused on preparing the airport to serve 100 million annual passengers in the next several years. Operation 2045 is phase two and is focused on preparing the airport for its 50th anniversary in 2045 and for an expected 120 million-plus annual passengers. The megatrends discussed in this report directly align with these initiatives by providing insights that will help DEN anticipate future challenges, capitalize on emerging opportunities, and implement innovative solutions to meet the demands of tomorrow's travelers.

Methodology: This report was developed using a comprehensive methodology that includes secondary research, stakeholder interviews, and comparative analysis with peer airports. Secondary research involved a thorough review of industry literature, government and regional planning documents, and reports from DEN's internal departments. Interviews with key stakeholders, including DEN executives and experts in various fields, provided valuable insights into how these megatrends are perceived and addressed within the organization. Comparative analysis with other major airports, such as Dallas-Fort Worth, Chicago O'Hare, and San Francisco International, was conducted to identify common strategies and best practices that could inform DEN's approach. This multi-faceted methodology ensures that the report is grounded in both quantitative data and qualitative insights, offering a well-rounded perspective on the implications of each megatrend for DEN.

Megatrend 1: A Changing Workforce

Overview: The "A Changing Workforce" megatrend refers to the profound transformation in work culture, operational methodologies, and employee expectations that have emerged over the past five years, particularly accelerated by the COVID-19 pandemic. This shift has led to new challenges and opportunities within the aviation industry, requiring organizations like Denver International Airport (DEN) to rethink their workforce strategies.

Critical Insights:

- **Workforce Evolution:** There has been a significant shift in how individuals approach work, with employees increasingly prioritizing flexibility, purpose-driven roles, and a balance between work and personal life. This trend has been especially pronounced among younger generations, such as Gen Z, who demand greater flexibility in where and how they work.
- **Increased Employee Turnover:** Post-pandemic, there has been a notable rise in voluntary resignations, reflecting broader trends in the aviation industry. DEN saw an increase from 291 voluntary resignations between 2018-2020 to 376 between 2021-2023, signaling the need for enhanced employee retention strategies.
- **Current Employee Expectations:** Modern employees are seeking more than just a paycheck; they want meaningful work, professional growth opportunities, and employers who prioritize their well-being. This is evident in the demand for hybrid and remote work options, professional development programs, and wellness initiatives.

Impact on DEN:

- **Strategic Workforce Planning:** As DEN approaches its Vision 100 goal of accommodating 100 million passengers, it must ensure it has a motivated and stable workforce. The changing expectations of employees necessitate a focus on creating a work environment that fosters satisfaction, retention, and productivity.
- **Employee-Centric Programs:** DEN has already begun addressing these workforce changes through initiatives such as exploring onsite childcare options, providing free transportation passes, and offering wellness programs. These efforts are aligned with the Vision 100 pillar of empowering people and will be crucial in maintaining a committed workforce as the airport continues to grow.

Action Items:

- **Expand Flexibility:** DEN should continue to explore and implement flexible working arrangements, including hybrid and remote work options, to meet the evolving expectations of its workforce.
- **Enhance Employee Development:** Invest in professional development programs, such as job-specific training, leadership development, and mentorship opportunities, to support employee growth and satisfaction.



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- **Improve Employee Well-being:** Further develop wellness initiatives to ensure that employees feel valued and supported in their roles.

Megatrend 2: Customers

Overview: The "Customers" megatrend focuses on the changing expectations and needs of passengers as they navigate through airports. With advancements in technology and an increasing demand for seamless and personalized travel experiences, airports must adapt to meet the rising expectations of their customers. For Denver International Airport (DEN), understanding and responding to these evolving customer needs is crucial to achieving its Vision 100 goals.

Critical Insights:

- **Technological Advancements:** Passengers are increasingly expecting airports to incorporate the latest technologies to enhance their travel experience. This includes biometric screening, self-service options, and smart infrastructure that streamlines the journey from curb to gate.
- **Demand for Seamless Travel:** Customers prioritize efficiency and convenience in their travel experience. Issues like slow processing times, inefficient lost and found systems, and lack of real-time information can significantly impact customer satisfaction.
- **Personalization and Services:** There is a growing expectation for personalized services, from tailored recommendations for dining and shopping to responsive customer service. Friendly staff and high-quality amenities are critical components of a positive airport experience.

Impact on DEN:

- **Enhanced Passenger Services:** To meet the evolving expectations of passengers, DEN must focus on optimizing its services, including faster processing times, improved customer support, and the integration of advanced technologies. Enhancing the application efficiency for mapping services and concession management will be essential.
- **Expansion of Amenities:** As part of Vision 100, DEN should consider expanding its amenities to cater to a broader range of passenger needs, including those related to health, wellness, and entertainment.
- **Focus on Technology:** Incorporating cutting-edge technologies such as robotics, automation, and advanced connectivity options will be crucial in providing a seamless and personalized experience for passengers at DEN.

Action Items:

- **Invest in Smart Infrastructure:** DEN should prioritize investments in smart infrastructure that supports seamless travel, including biometric screening, automated services, and enhanced connectivity throughout the airport.
 - **Optimize Customer Service Processes:** Address identified pain points, such as the lost and found system and parking management, to improve overall customer satisfaction.
 - **Expand and Personalize Amenities:** Enhance the range of amenities available at DEN, focusing on personalization and responsiveness to customer preferences. This includes expanding dining options, improving retail experiences, and offering wellness services.
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Megatrend 3: Technology Innovations

Overview: The "Technology Innovations" megatrend highlights the rapid technological advancements that are revolutionizing the aviation industry. These innovations, ranging from electric vehicles to artificial intelligence and digital twins, are not only enhancing operational efficiency but are also redefining the passenger experience. For Denver International Airport (DEN), staying at the forefront of these technological changes is essential for achieving its Vision 100 goals.

Critical Insights:

- **Electric Vehicles (EVs):** Transitioning to electric vehicles is a critical step toward reducing carbon emissions and increasing sustainability. Currently, only 6% of DEN's fleet is electrified. However, the push towards full electrification faces challenges, including the strain on existing power supplies and the need for dedicated power stations.
- **Wayfinding Innovations:** Enhancing wayfinding through the use of advanced technologies such as augmented reality, biometric identification, and smart carts is essential for improving passenger experience. These innovations aim to reduce congestion, make public transit easier to locate, and provide personalized navigation to passengers, especially in a complex and busy airport like DEN.
- **Artificial Intelligence (AI):** AI is beginning to significantly impact the aviation sector. Applications such as biometric security and digital twins for predictive maintenance are transforming operations at DEN. However, challenges remain in protecting information security, providing accurate responses, and managing the high energy consumption associated with AI technologies.
- **Digital Twins:** Digital twins represent a groundbreaking innovation in airport management. By creating a digital replica of DEN, this technology allows for real-time monitoring, predictive analytics, and simulation of emergency responses. It integrates diverse systems like air traffic control and baggage handling, providing a comprehensive tool for optimizing airport operations.

Impact on DEN:

- **Sustainability Initiatives:** The move towards electric vehicles supports DEN's sustainability goals, but it requires significant infrastructure upgrades, including the expansion of power capacity and the adoption of clean energy sources like solar and hydrogen.
- **Enhanced Operational Efficiency:** AI and digital twins will be key in optimizing DEN's operations, from reducing passenger wait times to improving resource allocation and maintenance processes. These technologies will help DEN stay competitive and resilient in the face of growing passenger numbers and operational demands.
- **Improved Passenger Experience:** Innovations in wayfinding and AI will directly enhance the passenger experience at DEN, making it easier for travelers to navigate the airport and access personalized information. This aligns with DEN's Vision 100 goals of providing a seamless and efficient airport experience.



Action Items:

- **Expand EV Infrastructure:** Invest in dedicated power stations, increase power capacity with additional transformers, and explore clean energy alternatives to support the electrification of DEN's fleet.
- **Implement Advanced Wayfinding Solutions:** Introduce interactive maps, improve DEN's mobile app, and test new technologies like holographic signs and robot guides to enhance passenger navigation and experience.
- **Leverage AI and Digital Twins:** Continue to develop and integrate AI applications for biometric security and operational efficiency. Implement digital twins for real-time monitoring and predictive analytics to improve airport management.

Megatrend 4: Funding Models

Overview: Funding Models are critical to supporting large-scale projects and operational needs. The funding strategies include various sources such as the Capital Improvement Program (CIP), Operating and Maintenance (ONM) funds, grants (e.g., FAA grants), and bonds (AMT and Non-AMT). Each of these models plays a vital role in enhancing infrastructure, supporting operational efficiency, and aligning with DEN's Vision 100 goal of accommodating 100 million passengers annually.

Critical Insights:

- **Public-Private Partnerships (P3s):** Though DEN initially explored a P3 contract for major renovations in 2017, it decided not to proceed. However, P3s remain a potential avenue for enhancing customer experience by partnering with local private companies for terminal upgrades and new amenities.
- **eVTOLs (Electric Vertical Takeoff and Landing Aircraft):** This emerging technology could provide new revenue streams through leasing, landing fees, and passenger facility charges. Though not immediately critical for DEN, staying ahead of this trend could offer a competitive edge and support high-end business travel.
- **Energy Performance Contracts (EPCs):** These contracts could potentially reduce upfront costs, improve sustainability, and align with long-term growth plans if explored further.

Impact on DEN:

- **Infrastructure and Customer Experience:** Adopting innovative funding models will be essential for balancing large-scale infrastructure projects with customer experience enhancements. Partnerships with private companies could help DEN improve passenger amenities and terminal services without relying solely on traditional funding sources.
- **Revenue Generation:** Exploring new technologies like eVTOLs could open up additional revenue opportunities for DEN. By staying ahead of emerging trends, DEN can diversify its income streams and better position itself for future growth.
- **Sustainability Goals:** If DEN decides to explore and implement Energy Performance Contracts, it could significantly reduce operational costs and enhance its sustainability efforts. This would align with DEN's long-term objectives of achieving environmental goals while managing financial resources efficiently.

Action Items:

- **Expand Public-Private Partnerships:** Engage with local companies to enhance passenger amenities, such as themed play areas or unique concessions, leveraging P3s to improve customer experience.
 - **Research eVTOL Opportunities:** Conduct feasibility studies to understand the demand and potential for eVTOL services in the Denver area, positioning DEN to capitalize on this emerging technology.
 - **Explore Energy Performance Contracts:** Investigate the potential benefits of EPCs, focusing on integrating advanced technologies and renewable energy sources to meet sustainability targets while controlling operational expenses.
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Megatrend 5: Privatization of Airports

Overview: From the Congressional Research Service (CRS) Report, privatization refers to “the shifting of governmental functions, responsibilities and sometimes ownership, in whole or in part, to the private sector.” For airports, it can range from outsourcing specific services to full-scale private operation or ownership of the airport. While full privatization of Denver International Airport (DEN) is not currently feasible, Public-Private Partnerships (P3s) offer a viable option for managing non-core functions more efficiently.

Critical Insights:

- **Targeted Privatization:** Privatizing non-core functions could enhance efficiency and generate additional revenue, allowing DEN to focus on its primary responsibilities, such as passenger processing and security.
- **Regulatory and Legal Challenges:** The FAA’s regulatory framework complicates privatization efforts, especially in maintaining eligibility for federal grants. Additionally, legal and political complexities, along with public perception, pose significant hurdles.

Impact on DEN:

- **Revenue Enhancement:** Implementing P3s could provide DEN with new revenue streams, which would be crucial for funding ongoing and future projects.
- **Operational Focus:** By transferring specialized tasks to the private sector, DEN could streamline its operations and allocate more resources to critical functions.

Action Items:

- **Identify Potential P3 Opportunities:** Conduct in-depth research to determine which functions at DEN would benefit most from privatization through P3s.
- **Engage Stakeholders:** Develop a comprehensive education campaign to engage internal (DEN) and external stakeholders, including the City Council and the Mayor’s office, to build support for privatization initiatives.
- **Private Sector Partners:** Reach out to potential private sector partners to identify their perspectives and challenges.

Megatrend 6: Sustainability

Overview: Sustainability is a core focus at Denver International Airport (DEN) as it strives to become the most sustainable airport in the world, as DEN grows to 100 million passengers and beyond. DEN's sustainability efforts encompass a wide range of initiatives aimed at reducing greenhouse gas emissions, increasing waste diversion, and improving energy efficiency, all while accommodating future growth.

Critical Insights:

- **Electrification and Sustainable Energy:** The transition to sustainable energy sources is challenged by existing infrastructure limitations, such as the lengthy timeframes needed to build new electrical substations, and the high energy demands of future technologies like electric aircraft.
- **Net Zero Construction:** Achieving net-zero emissions through construction requires more than just adhering to LEED standards; it demands innovative approaches such as microgrids and geothermal energy to meet the increasing energy demands of sustainable infrastructure.
- **Sustainable Aviation Fuel (SAF):** SAF adoption is crucial for reducing DEN's Scope 3 emissions, which account for most of the airport's greenhouse gas emissions. However, the market for SAF is underdeveloped, particularly in regions outside of California and Europe.
- **Climate Resiliency:** Rising temperatures pose significant risks to DEN's operations, including impacts on workforce safety, equipment reliability, and aircraft performance. There is a need for comprehensive climate risk management strategies to mitigate these risks.

Impact on DEN:

- **Energy Infrastructure Challenges:** DEN's ability to meet its decarbonization goals is constrained by existing energy infrastructure, requiring strategic planning and partnerships to ensure the availability of sufficient electrical capacity.
- **Operational Adjustments:** DEN will need to incorporate advanced technologies and infrastructure solutions, such as modular electric boilers and microgrids, to maintain sustainability while supporting airport operations.
- **SAF Integration:** Supporting the development of SAF infrastructure and policies in the Rocky Mountain region will be critical for DEN to reduce its Scope 3 emissions and achieve its long-term sustainability goals.
- **Climate Risk Management:** DEN must enhance its climate resiliency planning, balancing sustainability efforts with the need to mitigate operational disruptions caused by extreme weather conditions.

Action Items:

- **Develop a Master Infrastructure Plan:** Prioritize infrastructure projects and collaborate with partners like Xcel Energy to prepare for future energy demands, including feasibility studies for geothermal energy and the potential for additional on-site renewable energy.
 - **Support SAF Infrastructure and Policy:** Advocate for SAF infrastructure development near DEN and work with government affairs teams to fill policy gaps that incentivize SAF production and adoption in the region.
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- **Enhance Climate Resiliency:** Share the outcomes of Project Darwin across DEN departments to foster a culture of environmental consciousness. Develop standardized ROI models to evaluate the impact of sustainability projects on operational resiliency.

Megatrend 7: Urban Population Growth & Demographics

Overview: Urban population growth and demographic changes are crucial trends influencing the future of Denver International Airport (DEN). As Denver and the surrounding region experience significant population increases, including a younger, more diverse demographic, the airport must adapt its infrastructure, services, and strategic planning to meet these evolving needs.

Critical Insights:

- **Population Growth:** The Denver metropolitan area currently has about 3 million residents, and this number is expected to double by 2050, with Denver and Boulder adding 1.39 million people. This growth will place substantial demands on DEN's infrastructure and services.
- **Demographic Shifts:** The population in Metro Denver is younger than the national average, with a significant portion in the 15-44 age range. This younger demographic has different expectations, particularly in terms of digital services and leisure travel, compared to older generations who may require more mobility options and physical interaction.
- **Infrastructure Demands:** The anticipated urban growth will increase traffic on Peña Boulevard, create more stress on DEN's existing infrastructure, and require adjustments in customer-facing facilities to accommodate a larger and more diverse customer base.

Impact on DEN:

- **Infrastructure Stress:** The rapid urban growth will significantly strain DEN's current infrastructure, necessitating upgrades and expansions to handle increased traffic, both in terms of passengers and vehicles.
- **Customer Experience:** The shifting demographic will demand more digitalized services and enhanced mobility options. DEN must cater to the needs of both younger travelers who prefer digital interactions and older travelers who may require additional physical support.
- **Regulatory and Environmental Concerns:** Increased population density and airport usage will heighten regulatory concerns, particularly around noise and air pollution, necessitating proactive management and planning.

Action Items:

- **Anticipate Customer Demands:** Invest in digitalizing the passenger experience and expanding mobility options for aging populations. Focus on sustainable resource utilization to manage environmental impacts.
 - **Expand Public Transportation:** Enhance access to DEN by expanding public transportation options, including designated lanes for buses and continued investments in rail infrastructure. Collaborate with regional transit authorities to manage the increased transportation demand.
 - **Engage with Stakeholders:** Work with peer airports to understand their strategies for managing urban growth. Engage with local communities to align DEN's development with regional needs and collaborate across multiple megatrends to integrate sustainability, customer experience, and workforce considerations into DEN's strategic planning.
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Conclusion

Summary of Megatrends: The seven megatrends explored in this report collectively represent a transformative force that will shape the future of Denver International Airport (DEN) and the broader aviation industry. These megatrends are:

- **A Changing Workforce:** The shift towards remote work, automation, and a diversified gig economy requires DEN to evolve its workforce strategies, focusing on flexibility, upskilling, and inclusivity.
- **Customers:** Changing passenger expectations, driven by digitalization and demographic shifts, necessitate enhancements in customer service, mobility options, and personalized experiences at DEN.
- **Technology Innovations:** Advancements in artificial intelligence, automation, and digital platforms are revolutionizing airport operations, prompting DEN to invest in smart technologies that enhance efficiency and security.
- **Funding Models:** The evolution of funding mechanisms, including Public-Private Partnerships (P3s) and innovative financing options like Energy Performance Contracts (EPCs), requires DEN to explore new revenue streams and investment strategies to support infrastructure and sustainability projects.
- **Privatization of Airports:** While full privatization may not be imminent for DEN, strategic partnerships and selective privatization of non-core operations can drive efficiency and generate revenue.
- **Sustainability:** As DEN aims to become the world's most sustainable airport, it must navigate challenges related to energy infrastructure, Sustainable Aviation Fuel (SAF) adoption, and climate resilience to meet its ambitious environmental goals.
- **Urban Population Growth:** The rapid population growth in the Denver region will increase demand on DEN's infrastructure and services, necessitating strategic expansions and enhancements in transportation access, customer facilities, and regulatory compliance.

These megatrends highlight the dynamic and interconnected nature of the challenges and opportunities facing DEN, underscoring the need for a proactive, adaptive approach to future planning.

Strategic Implications for DEN: The megatrends identified in this report provide a critical framework for DEN's strategic planning and innovation initiatives. By understanding these trends, DEN can:

- **Enhance Operational Efficiency:** Through the adoption of new technologies and automation, DEN can streamline operations, reduce costs, and improve the passenger experience.
- **Prioritize Sustainability:** By focusing on sustainable practices and infrastructure, DEN can achieve its Vision 100 and Operation 2045 goals, positioning itself as a leader in environmental stewardship within the aviation industry.
- **Foster an Inclusive and Diverse Environment:** By addressing the diverse needs of its evolving customer base and workforce through a strong commitment to equity, diversity, inclusion, and accessibility, DEN can maintain high levels of service and attract top talent, ensuring long-term success.



- **Enhance Customer Experience Through Innovative Funding:** By expanding the use of P3s and other innovative financing mechanisms, DEN can secure the necessary resources to support its growth and modernization projects, while also enhancing the customer experience through improved facilities and services.

These strategic implications make it clear that DEN must continue to innovate and adapt in response to these megatrends to remain competitive and resilient in a rapidly changing global landscape.

Next Steps: To effectively address these megatrends and ensure long-term success, DEN should consider the following next steps:

1. **Develop a Comprehensive Workforce Strategy:** Invest in upskilling, diversity initiatives, and flexible work arrangements to attract and retain top talent while preparing the workforce for future challenges.
2. **Invest in Digitalization and Customer Experience:** Enhance the digital passenger journey, expand mobility options, and tailor services to meet the needs of both younger and aging demographics.
3. **Pursue Strategic Partnerships:** Explore additional opportunities for Public-Private Partnerships and other collaborative ventures to fund key projects, particularly those related to sustainability and infrastructure expansion.
4. **Advance Sustainability Initiatives:** Continue to prioritize sustainable infrastructure, such as renewable energy sources and Sustainable Aviation Fuel (SAF), while enhancing climate resilience measures to mitigate the impact of extreme weather events.
5. **Expand Infrastructure to Meet Urban Growth:** Upgrade and expand DEN's infrastructure to accommodate the growing population, including improvements to transportation access, customer facilities, and environmental management systems.
6. **Engage with Stakeholders and Community:** Foster ongoing collaboration with local communities, regional transit authorities, and industry peers to align DEN's development with broader regional and global trends.

By taking these steps, DEN can proactively address the challenges and opportunities presented by these megatrends, positioning itself for continued success and leadership in the aviation industry.

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Appendices

1. *A Changing Workforce*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
2. *Customers*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
3. *Technology Innovations*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
4. *Funding Models*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
5. *Privatization of Airports*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
6. *Sustainability*. (2024). Denver International Airport. [\(Link to Presentation\)](#)
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