

FOLLOW-UP REPORT

Denver International Airport *Data Centers*

MARCH 2022



TIMOTHY M. O'BRIEN, CPA
DENVER AUDITOR

OFFICE OF THE AUDITOR
AUDIT SERVICES DIVISION, CITY AND COUNTY OF DENVER

Audit Team

Jared Miller, CFE, CISA, CDPSE, Information Systems Audit Manager

Karin Doughty, CISA, CDPSE, Information Systems Audit Lead

Nicholas Jimroglou, CISA, CDPSE, Information Systems Audit Lead

Audit Management

Timothy M. O'Brien, CPA, Auditor

Valerie Walling, CPA, Deputy Auditor

Dawn Wiseman, CRMA, Audit Director

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copies of this
report by
contacting us:



Office of the Auditor

201 West Colfax Avenue, #705

Denver CO, 80202

(720) 913-5000 | Fax (720) 913-5253

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City and County of Denver



TIMOTHY M. O'BRIEN, CPA
AUDITOR

201 West Colfax Avenue, #705, Denver, Colorado 80202
(720) 913-5000 | Fax (720) 913-5253 | www.denverauditor.org

AUDITOR'S LETTER

March 3, 2022

In keeping with generally accepted government auditing standards and Auditor's Office policy, as authorized by city ordinance, the Audit Services Division has a responsibility to monitor and follow up on audit recommendations to ensure city agencies address audit findings through appropriate corrective action and to aid us in planning future audits.

Our original audit evaluated data centers operated by both the city and Denver International Airport. However, this follow-up report addresses only the seven recommendations we made to the airport's Business Technologies Division. We reported on Technology Services' implementation efforts in a previous follow-up report, issued in September 2020.

In our remaining follow-up effort for the "Data Centers" audit report issued in January 2019, we determined the airport's Business Technologies Division fully implemented five of the seven recommendations it agreed to in the original audit report. It has not yet implemented the other two recommendations. Therefore, despite Business Technologies' efforts, auditors determined the risks associated with the audit team's initial findings have not been fully mitigated. As a result, the Audit Services Division may revisit these risk areas in future audits to ensure the city takes appropriate corrective action.

The Highlights page in this report provides background and summary information about the original audit and the completed follow-up effort. Following the Highlights page is a detailed implementation status update for each recommendation. We have communicated separately with the Business Technologies Division about the status of additional recommendations we reported confidentially because of their sensitive nature.

I would like to express our sincere appreciation to the airport personnel in the Business Technologies Division who assisted us throughout the audit and the follow-up process. For any questions, please feel free to contact me at 720-913-5000.

Denver Auditor's Office

A handwritten signature in black ink, appearing to read "Timothy M. O'Brien".

Timothy M. O'Brien, CPA
Auditor



Data Centers

MARCH 2022

Objective

This audit evaluated the two data centers serving Denver International Airport. The data centers were assessed for efficiency and effectiveness of operations against applicable standards to ensure the security and the operability of technology assets, such as equipment, facilities, and infrastructure.

Background

Data centers house critical information technology assets, including servers, routers, and other devices. The airport is responsible for a primary and a secondary data center. These two data centers use a mix of cloud-based and in-house technology solutions.

Denver International Airport’s Business Technologies Division is responsible for the information technology infrastructure and services used by the airport, including the data centers we audited.

ORIGINAL REPORT HIGHLIGHTS

Data Center Infrastructure Could Not Easily Adapt to Changes in Operations

The existing data centers did not provide sufficient geographic diversity.

Data Center Operations Lacked Application Reviews, Cost Data, and Collaboration between Technology Services and Business Technologies

- No process was in place to review and approve the continuing use of software applications running in the data centers to ensure they still provided appropriate value.
- The Business Technologies Division did not track the costs of application services, making it impossible to truly determine the cost of providing or changing these services.
- The Technology Services agency and the Business Technologies Division did not share their data center management tools and knowledge, so they missed out on opportunities for cost-savings and efficiency.

Technology Services and the Airport Did Not Employ Consistent Operational Standards at All Data Center Locations

The continuity of operations plan for the airport data centers was outdated.

WHY THIS MATTERS

Because it is a standalone entity owned by the city, the airport has its own data centers that need to provide real-time support for critical airport operations.



5

FULLY IMPLEMENTED



0

PARTIALLY IMPLEMENTED



2

NOT IMPLEMENTED

March 3, 2022

Action Since Audit Report

Data Centers

7 recommendations proposed to Business Technologies in January 2019



FULLY
IMPLEMENTED

5



PARTIALLY
IMPLEMENTED

0



NOT
IMPLEMENTED

2

Denver International Airport's Business Technologies Division fully implemented five recommendations made in the original audit report, but two others have yet to be fully implemented or acted upon.

Our follow-up work found Denver International Airport's Business Technologies Division tracks overall data center costs and energy use, collaborates and shares knowledge with the city's Technology Services agency, includes the new data center in its continuity of operations plan, and has developed a new process for application reviews.

However, the airport delayed its efforts to find another internet solution because of the COVID-19 pandemic in 2020. Until another internet solution is implemented, the airport's data centers will continue to rely on a single internet service provider. This puts those facilities at continued risk when internet service is disrupted.

Because of the airport's delay in addressing its internet service provider, the airport also has not yet determined whether its secondary data center should be relocated or improved.

Finding 1 | Data Center Infrastructure Cannot Easily Adapt to Changes in Operations

Recommendation 1.2



**NOT
IMPLEMENTED**

ADDRESS INTERNET SERVICE SOLUTION (BUSINESS TECHNOLOGIES) – Denver International Airport should continue implementing a more robust internet service solution as soon as possible.

AGENCY ACTION

Original target date for completion: Dec. 31, 2020

During the original audit, the airport’s Business Technologies Division agreed with the recommendation and requested nearly two years to implement a solution because of the requirements involved with contracting and construction.

After the audit, Business Technologies decided on requirements for an internet service solution and requested proposals from interested vendors. Business Technologies staff evaluated proposals in 2019, selected a vendor, and began negotiating a contract.

However, during the COVID-19 pandemic in 2020, Business Technologies leadership advised the airport’s chief information officer to pause this process. Business Technologies staff told us they plan to issue a new request for proposals in 2023 to ensure they consider new requirements.

However, until another internet solution is implemented, the airport’s data centers will continue to rely on a single internet service provider. This puts those facilities at continued risk when internet service is disrupted. Therefore, this recommendation is not implemented.

Recommendation 1.3



**NOT
IMPLEMENTED**

ASSESS SECONDARY AIRPORT DATA CENTER (BUSINESS TECHNOLOGIES) – After implementing Recommendation 1.2, Denver International Airport should perform an evaluation to determine if its secondary data center should be relocated or augmented.

AGENCY ACTION

Original target date for completion: April 1, 2021

During the original audit, Business Technologies officials said implementing this recommendation would depend on them completing Recommendation 1.2 first.

Business Technologies staff now estimate they will complete this recommendation in 2023, a few months after they implement a new internet service solution.

Therefore, this recommendation is not implemented.

Finding 2 | Data Center Operations Lack Application Reviews, Cost Data, and Collaboration between Technology Services and Business Technologies

Recommendation 2.2

PERFORM PERIODIC APPLICATION REVIEW (BUSINESS

TECHNOLOGIES) – Denver International Airport’s Business Technologies Division should enhance its existing process, as soon as possible, for reviewing the business justification and appropriateness of software applications. This review process should occur at least every three to five years, include all applications, and be done in consultation with application owners.



**FULLY
IMPLEMENTED**

AGENCY ACTION

Original target date for completion: Sept. 1, 2019

Since the original audit, the airport’s Business Technologies Division created an application portfolio and developed a review process and template for assessing applications.

The review process includes evaluating how well an application meets the airport’s needs – including ease of use, reporting capabilities, ability to support business growth, and how well it meets technology requirements or standards. Technology requirements include product availability, vendor support and viability, and security.

As a part of this process, Business Technologies scores each application in these areas to determine whether the application remains a good fit or whether it should be evaluated for replacement.

Business Technologies staff have been conducting application reviews periodically since 2018, and this process has evolved since our original audit was published in January 2019. Since our follow-up began, staff have been conducting these reviews over the last several months.

Therefore, we consider this recommendation fully implemented.

Recommendation 2.4

TRACK DATA CENTER COSTS (BUSINESS TECHNOLOGIES) – Denver

International Airport’s Business Technologies Division should track costs associated with providing data center support. These tracked costs should include:

- **PERSONNEL COSTS** – including salaries and benefits.



**FULLY
IMPLEMENTED**

- **BUILDING COSTS** – including utilities, insurance, and other direct facility costs.
- **INFORMATION TECHNOLOGY INFRASTRUCTURE COSTS** – including hardware and supporting software, such as operating systems costs.
- **APPLICATION-SPECIFIC COSTS** – including licensing, specific hardware needs, and maintenance costs

AGENCY ACTION

Original target date for completion: May 1, 2019

The Business Technologies Division tracks data center expenses in 13 categories, including staff augmentation, information technology power costs, facility operations management fees, power monitoring, and planned upgrades.

Division staff review costs on a regular basis with Johnson Controls, the third-party data center operations firm responsible for periodic maintenance of the data center. In addition, Business Technologies created a procedure to monitor and report on data center energy costs.

Because of this progress in tracking data center costs, we consider this recommendation fully implemented.

Recommendation 2.5



**FULLY
IMPLEMENTED**

COLLABORATE TO SHARE TOOLS AND KNOWLEDGE – The city’s Technology Services agency and the airport’s Business Technologies Division should share knowledge, tools, and the technology they use to manage their data centers. These combined tools should provide the equivalent of a data center infrastructure management tool set.

AGENCY ACTION

Original target date for completion: May 1, 2019

During the original audit, we found that Business Technologies and the city’s Technology Services agency worked independently and rarely shared their knowledge of the various tools and techniques they use to run their data centers. This lack of collaboration could lead to missed opportunities for cost-savings and efficiency.

During follow-up, we learned Business Technologies and Technology Services met in April 2019, after we published our original audit report. The agencies’ conversations continued for several months thereafter.

These discussions included addressing “lessons learned.” While the two agencies did not meet each quarter as they had initially planned, we did review evidence that staff discussed, at a minimum, sharing tools with one another.

Therefore, we consider this recommendation fully implemented.

Recommendation 2.7

TRACK ENERGY USE (BUSINESS TECHNOLOGIES) – Denver International Airport’s Business Technologies Division should set up a process as soon as possible to track, at a minimum, total energy costs for each data center. In the long term, the division should perform an analysis of energy costs down to the device-level for each data center starting in 2020.



**FULLY
IMPLEMENTED**

AGENCY ACTION

Original target date for completion: May 1, 2019

In our original report, we found Business Technologies used a data center infrastructure management tool, but staff were not using the tool to its fullest extent. For example, it was not configured to track total energy use in the data centers.

During follow-up, we learned Business Technologies configured its tool to track energy use and notify staff when energy use exceeds set thresholds. Such tracking enables data center operators to pinpoint trouble spots and find excess capacity, which maximizes the possibilities for energy- and cost-savings especially when combined with an infrastructure management tool.

Determining the cost per kilowatt at the data centers can be a difficult task. Rate costs can change because of varying factors including the time of day, how many hours of use, and the location in the data center where energy is drawn.

As a result, Business Technologies staff estimated the cost per kilowatt and set energy thresholds to alert them when energy use exceeded them. We reviewed an example of an email notification when the energy voltage exceeded the threshold, and we determined the notifications are working as intended.

Therefore, we consider this recommendation fully implemented.

Finding 3 | Technology Services and the Airport Should Employ Consistent Operational Standards at All Data Center Locations

Recommendation 3.5



**FULLY
IMPLEMENTED**

UPDATE CONTINUITY OF OPERATIONS PLANS (BUSINESS TECHNOLOGIES) – Denver International Airport’s Business Technologies Division should work with Denver International Airport’s continuity of operations planning administrator to create an annual process to review and approve continuity of operations plans for its data centers.

AGENCY ACTION

Original target date for completion: May 1, 2019

In our original report, we found Business Technologies did not include the South Campus Data Center in its continuity of operations plan. During follow-up, we learned Business Technologies reviews its continuity of operations plan every six months and has since included the South Campus Data Center.

To verify this, we reviewed a continuity of operations plan that was updated on Nov. 9, 2021. We found the plan was updated to reference the South Campus Data Center as an alternative data center. The plan includes maintaining the physical network and establishing a means of communication should both airport data centers go offline.

This updated continuity of operations plan reduces the risk of the airport not being able to resume data center operations after an emergency or disaster.

As a result, we consider this recommendation fully implemented.

Office of the Auditor

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201 West Colfax Avenue #705

Denver CO, 80202

(720) 913-5000 | Fax (720) 913-5253

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