

The Evolution of Wayfinding Within Airports

Bonnie Powell

Transportation Research Board Conference

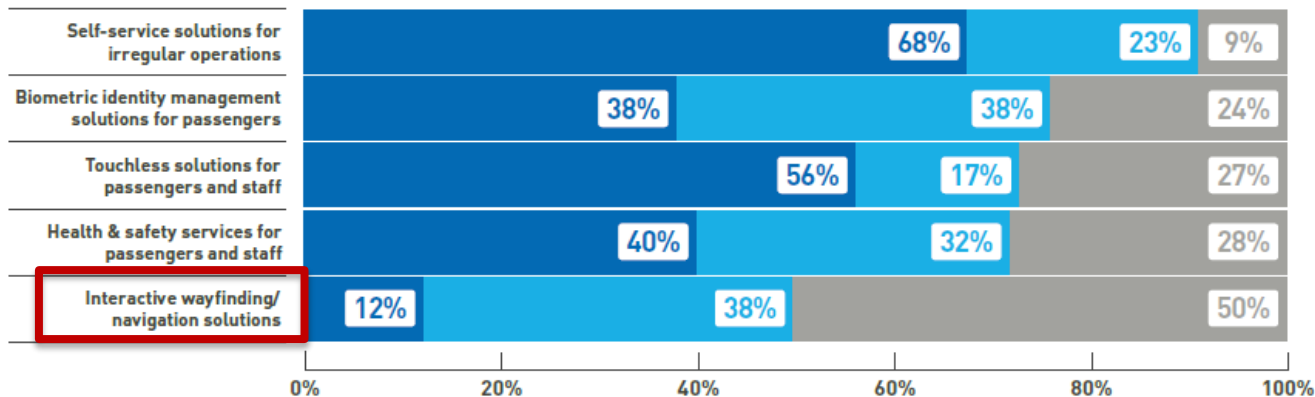
Washington, D.C.

January 9th, 2024

Wayfinding Motivation

- Improve passenger experience
- Reduce energy consumption

AIRLINE INVESTMENT PRIORITIES AT AIRPORT



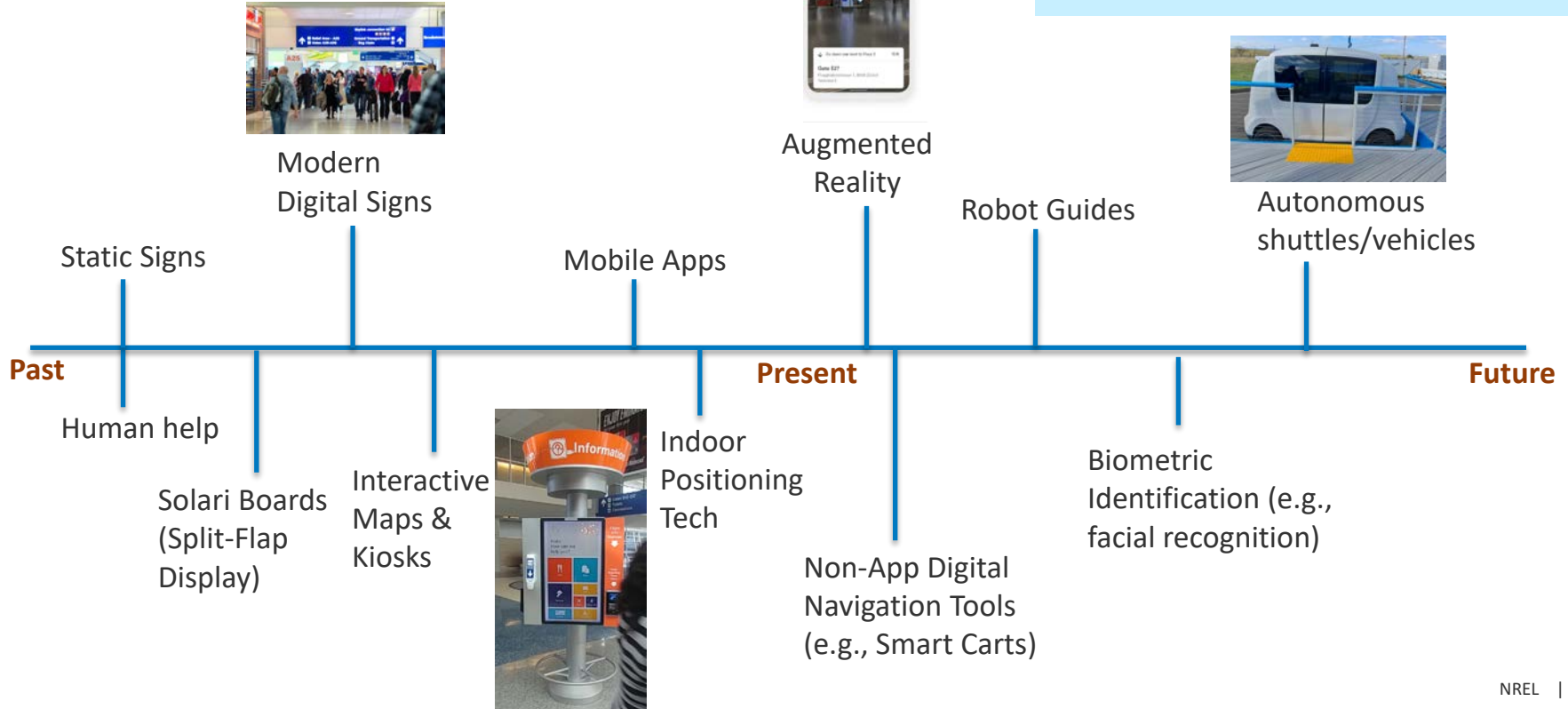
% of airlines with implemented or planned initiatives at airport by 2024

Source: [SITA 2021 Air Transport IT Insights Report](#)

Wayfinding Technology Timeline

Considerations

- **Integration** of numerous technologies
- Many wayfinding technologies do not disappear, additional technologies are just added



Wayfinding Technologies

1. Static, digital signs

- Key long-term fixtures
- Digital signs prevalent for dynamic information
- Can have multiple purposes (e.g., advertising + directions)
- U.S. Federal Aviation Administration (FAA) has design guidelines for terminals signage
- Languages displayed is a key consideration

Innovative Example



Prague Airport: signs change language throughout day based on passenger make-up

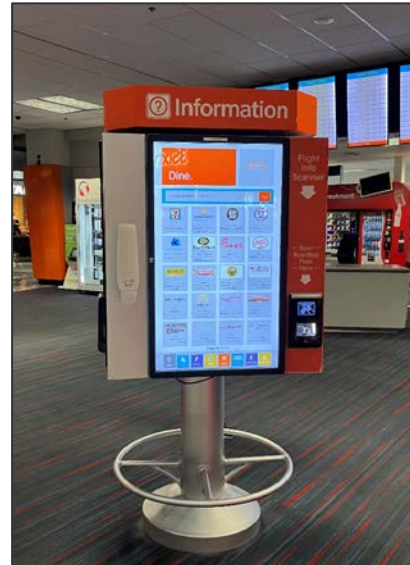
Photo from [Kiwi.com](https://www.kiwi.com)

Wayfinding Technologies

2. Interactive Displays

- User input
- Allow for more personalized information
- However, only one person can use a display at a time

Innovative Example



Dallas Fort Worth (DFW) Airport: interactive information kiosks

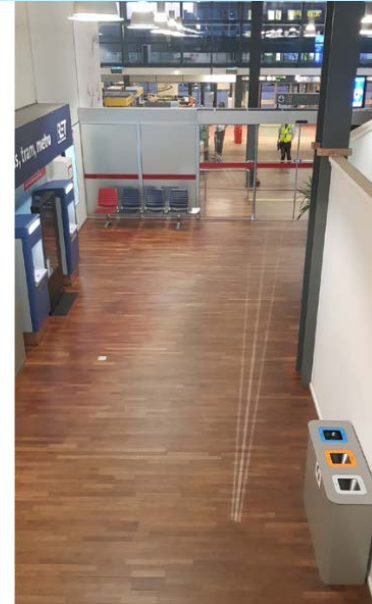
The user scans their boarding pass to get personalized directions. *Photos taken May 27, 2023 by Bonnie Powell (left), and Nov. 1, 2021 by Stanley E. Young (right).*

Wayfinding Technologies

3. Floor-Based Navigation

- Sign projection systems
- Can change based on the passenger makeup and time of day (e.g., using different languages or changing placement)
- Can be useful for certain groups (e.g., wheelchair users with a lower field of vision)
- May catch attention of travelers looking at smartphones while walking

Innovative Example



Rotterdam The Hague International Airport (Netherlands): projection directing travelers toward the exit.

Photo from a field study conducted by Tezcan and Hiemstra-van Mastrigt (2019). Color contrast between ground and digital projection and animating the projected were key considerations.

Wayfinding Technologies

4. Employee-Provided Guidance

- Information desks have become less staffed over time, sometimes replaced with help text lines and mobile apps
- Volunteer airport ambassadors are often still prevalent

Innovative Example

Information Assistance



Click the “Connect Live Now” icon to the left to connect via video or text with our Customer Service Agents between the hours of 6 a.m. and 10:30 p.m. daily.

When you connect with our agents, you will know you are in good hands. They are knowledgeable about DEN and the products and services DEN has to offer and can even help you navigate the airport.

Other ways to connect are:

Text or call us from 6 a.m. to 10:30 p.m. daily.

TEXT us your questions at (720) 902-9351.

CALL us at (720) 730-IFLY (4359)

Denver International Airport (Colorado, USA):
live video or chat help.

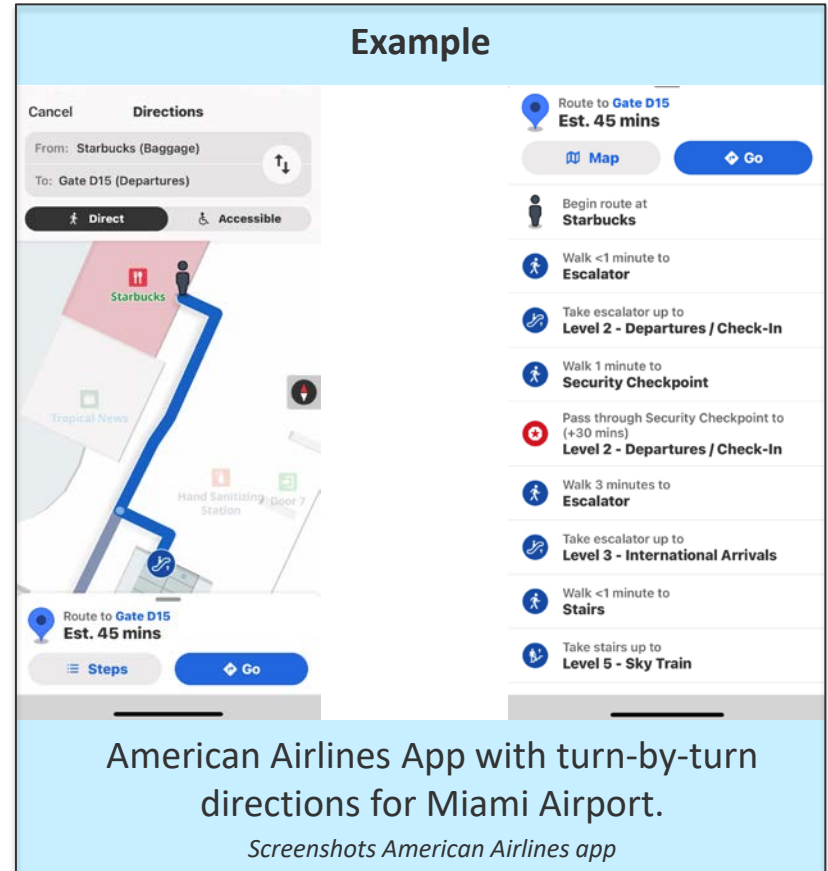
Screenshot from DIA’s information assistance webpage:

https://www.flydenver.com/traveler_services/information-assistance

Wayfinding Technologies

5. Mobile Apps and Augmented Reality (AR)

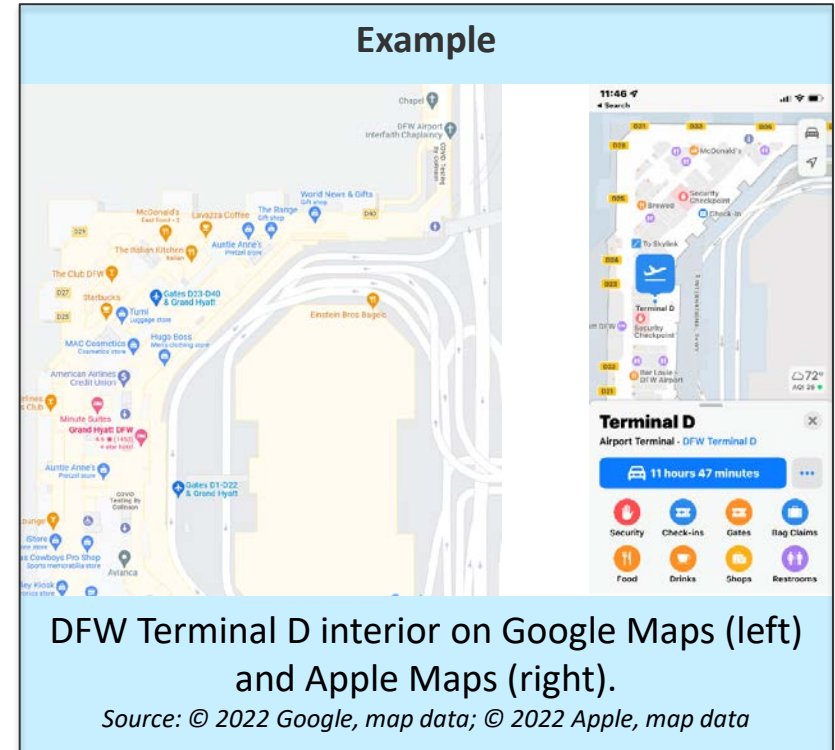
- Airport and airline apps (e.g., Denver International Airport app, American Airlines app)
 - Maps are just one feature of the app



Wayfinding Technologies

5. Mobile Apps and Augmented Reality (AR)

- Third-party apps (e.g. Google, Apple)
- Some airports and airlines have private partnerships to develop apps
- Apps are moving towards a “one-stop shop” for multiple customer needs during travel
 - But many still only focus on a few pieces of the travel experience



Wayfinding Technologies

5. Mobile Apps and Augmented Reality (AR)

- AR apps: Indoor Google Maps (Live View) launched in March 2021
 - Uses a smartphone's camera to scan location, then shows directions on the screen (AR)
 - Compares images to database of facility images to determine traveler's orientation
 - Displays directions superimposed on the camera image

Innovative Example



Google Maps Indoor Live View augmented reality directions in John F. Kennedy International Airport (New York City) Terminal 4.

Screenshot from Google Maps app taken by Bonnie Powell on Nov. 22, 2023.

Wayfinding Technologies

5. Mobile Apps and Augmented Reality

- App Challenges:
 - Balancing holding a phone and other items while moving
 - Some travelers do not have or cannot easily operate a smartphone
 - Potential for conflicting information between the app and built environment
 - Potential for conflicting interests (e.g., commercial interests and traveler interests)

Innovative Example



Google Maps Indoor Live View augmented reality directions in John F. Kennedy International Airport (New York City) Terminal 4.

Screenshot from Google Maps app taken by Bonnie Powell on Nov. 22, 2023.

Wayfinding Technologies

6. Indoor Positioning Technology

- GPS technology revolutionized outdoor navigation
- No comparable solution for indoor navigation yet

Examples

- Comparing smartphone digital camera image to database of building photos (e.g., Google)
- **Bluetooth low energy (BLE)** and **Ultra-Wideband (UWB) beacons**
 - Common-Use Beacon Registry (set up by SITA), aids app developers

Considerations

- **Customer experience** – risk of notification fatigue
- Customer and employee **privacy**
- **Competition** between airport, airlines, third-parties for data

Wayfinding Technologies

7. Biometric Technology

- Facial recognition can be used for purposes beyond security
- Concerns about privacy and higher inaccuracies among certain groups (such as those with darker skin, women, and older adults)
- Examples
 - Delta Air Lines' PARALLEL REALITY™ technology: displays personalized information on a screen to multiple passengers at the same time

Innovative Example



Delta's PARALLEL REALITY™ experience under construction at the Detroit Metropolitan Airport.

Photo taken by C. Alexander Hirst on June 15, 2022

Wayfinding Technologies

8. Robot Guides

Example



Incheon International Airport, South Korea
(July 2018)

Photo from [Korea JoongAng Daily](#)

9. Miscellaneous Digital Navigation Tools

Examples

- Cairo International Airport, Chicago O'Hare International Airport, CVG Airport (and more): self-guided **online virtual tours** to familiarize travelers with an airport prior to arrival
- San Diego International Airport: **airport carts** with screen displaying personalized information and directions
- Cincinnati/Northern Kentucky International Airport (CVG) Airport: **3D hologram** planned to guide travelers in the correct direction when exiting an escalator

Other Considerations: Autonomous Vehicles

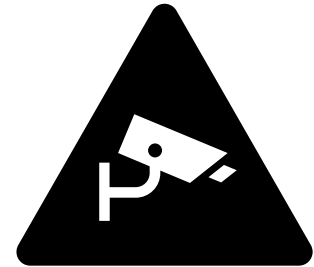
- How will wayfinding strategies integrate into autonomous transit within airports?
 - Autonomous wheelchairs
 - Autonomous shuttles (fixed-route or on-demand)
 - Vertiports for electric vertical take-off and landing (eVTOL) aircraft



Glydways on-demand autonomous shuttle.
Photo taken by Stan Young on Feb. 2, 2023.

Other Considerations: Legal Considerations

- Various legal considerations related to **privacy** and **sharing data** in modern wayfinding
 - Compliance with privacy laws
 - Public opinion related to data collection and sharing
 - Potential tensions between airlines, airports, and third-party app developers vying to cater to the same customer market



Other Considerations: Traveler Stress

- Interest in quiet spaces and outdoor areas has accelerated in recent years
- International airports have led the way
- Opportunities to incorporate quiet spaces into wayfinding
- Examples
 - Singapore’s Changi Airport: garden spaces, walking trails, waterfalls
 - Seattle-Tacoma Airport: “sensory room” for customers sensitive to stimuli, prayer/meditation room
 - Denver International Airport: outdoor decks

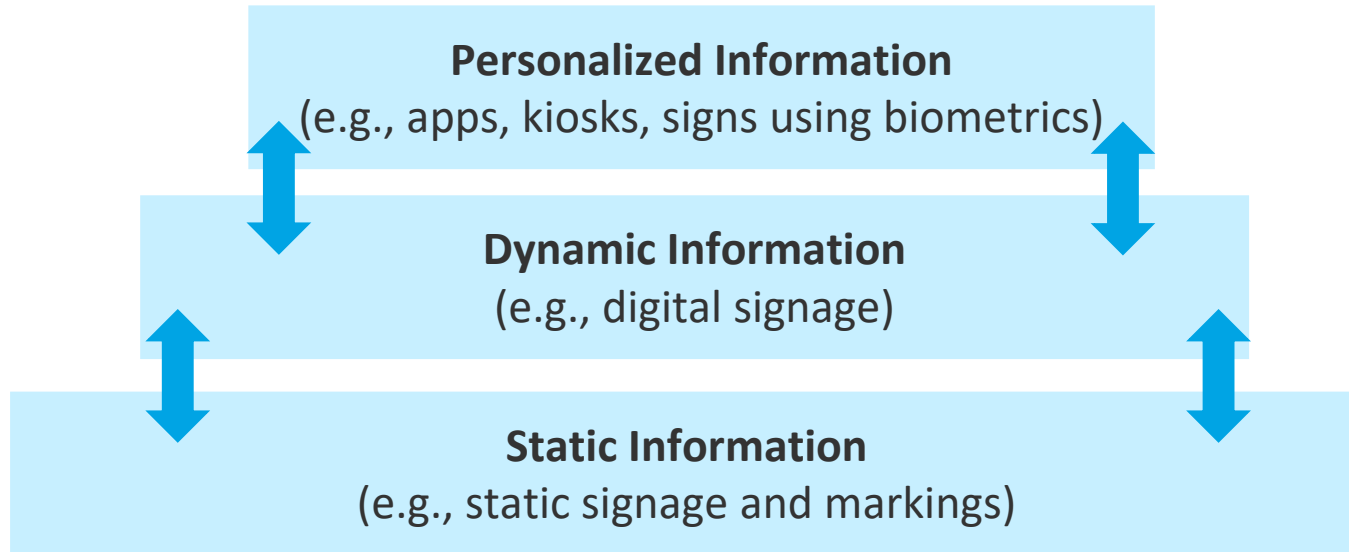


Syracuse Hancock International Airport (New York):
Escape Pod for taking business calls.
Photo taken by Bonnie Powell on Jan. 8, 2023.



Houston George Bush Intercontinental Airport:
Centurion Lounge with “Calm” meditation app access
Photo from [Condé Nast Traveler](#)

Framework



Conclusion



Rapidly changing area



Smartphone apps and push-notifications is anticipated path forward, but have challenges

- Notification fatigue: apps can overload travelers
- Difficult to balance smartphone navigation in dynamic situations
- Must overcome 'local positioning problem' for widespread adoption



Electronic wayfinding does not replace, but rather **augments traditional methods**

- Well designed, easy to navigate airport is the foundation
- Effective, up-to-date static signage remains essential
- Electronic bridges to interactive and customized wayfinding capabilities



Powerful partnership opportunities moving forward



Human behavior studies are critical to any plan or investment; could prevent the deployment of costly and ineffective technologies

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Questions?

www.nrel.gov

NREL/PR-5R00-88433

Full report available here:



<https://www.nrel.gov/docs/fy24osti/83211.pdf>

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