

NCIT
The National Center for Intermodal Transportation

IMPLICATIONS OF SYSTEM USABILITY ON INTERMODAL FACILITY DESIGN

FINAL REPORT

August 2010

PRINCIPAL INVESTIGATORS:

Lesley Strawderman

John M. Usher

1.0 Abstract

Ensuring good design of intermodal transportation facilities is critical for effective and satisfactory operation. Passenger use of the facilities is often hindered by inadequate space, a poor layout, or lack of signage. This project aims to improve the design of transportation facilities by first understanding how passengers use the facilities. A cognitive model was created for three common airport tasks: departing, transferring, and arriving at an airport. The model, which defines the physical and cognitive steps required for a passenger to complete each task, was validated using focus groups. Researchers then visited 10 airports to assess the ability of a passenger to complete the tasks using those exact steps at each facility. The results of the model, focus groups, and airport visits were used to develop a number of design guidelines addressing multiple aspects within a facility, including signage, facility layout, and user tasks and processes.

2.0 Introduction

Passenger use of intermodal transportation facilities is a necessary component of any passenger travel. Effective use of facilities is essential to the provision of adequate and useful transportation options to passengers. An effective facility is one that allows users to accomplish their objectives (e.g. park their car and catch the 5:20 train to Smithtown on time), minimizes frustration and errors, and leaves passengers satisfied with the experience. This is defined as a *usable* intermodal facility. Designing facilities with *usability* in mind allows for the easier attainment of the aforementioned traits: high accomplished objective rate, low frustration, few errors, and high traveler satisfaction. One way of creating highly *usable* facilities is by matching the facility design and use to user's mental models of the same system. A person's mental model is their cognitive depiction of how the system should operate. If the facility operates in the same manner as a user's mental model, it is much easier to provide them with an effective and usable transportation experience. This project seeks to create a validated mental model of pedestrian use of intermodal facilities, evaluate the usability of facilities based on this model, and develop design guidelines to improve facility usability.

According to the Airport Cooperative Research Program within Transportation Research Board (TRB), "Airport terminal and landside projects are projected to account for well over one-half of the planned development costs at large- and medium-hub airports in the United States over the next 5 years [1]." Thus, the development of design guidelines for intermodal facilities could not be timelier. The creation of design guidelines for transportation facilities is not new, there are already some guidelines in existence. However, the majority of these guidelines are focused only on the physical aspects of pedestrian movement, as is the case with the most commonly used guidebook, the Highway Capacity Manual (HCM) [2]. The guidelines within the HCM are based on past empirical studies [3-5], but fail to include some pertinent aspects of pedestrian behavior. Researchers have attempted to remedy this situation by including pedestrian's perceptions of facilities [6, 7] or by combining the physical and psychological aspects of a pedestrian's travel [8].

Although some research has included the psychological aspects of travel, very little research with respect to facilities design has focused on pedestrians' objectives or travel agendas. Benz [9] developed a time-space approach to facility evaluation and design that was calculated based on a pedestrian's initial travel agenda. However, it did not allow for modification, or an analysis of the ability

of a pedestrian to complete their planned agenda. Even within research addressing travel agendas, studies have not focused on what takes place inside transportation facilities themselves. Studies tend to center on travel agendas for an entire trip, making the development of facilities design guidelines difficult. This project seeks to circumvent these shortcomings by developing facility design guidelines based on empirical data and pedestrian's mental models.

3.0 Project Objectives

This project aims to develop intermodal facility design guidelines based on user's expectations and perceptions of facility use. The objectives of this project are as follows:

- Develop a generalized mental model for passenger travel (section 4).
- Validate the model using empirically collected data (section 5).
- Compare the model to existing intermodal passenger facilities to assess usability (section 6).
- Develop design guidelines for facilities based on the comparison of passengers' mental models to existing facility designs (section 7).

4.0 Model Development

4.1 Methodology

Three scenarios were selected to explore the usability of an airport. These scenarios were chosen from 36 brainstormed procedures that best represented a traveler's most frequent actions. The three scenarios together compose a complete flight process, and they are:

1. Departure: Drive to airport, park the car in long-term parking, walk to main terminal, go to ticket counter representative or Kiosk to check in for flight, check bags, proceed through security, and proceed to your departure gate.
2. Transfer: Disembark plane, check departure gate, walk to inside airport rail, take inside rail to a concourse, exit rail and walk to departure gate.
3. Arrival: Disembark from plane, claim luggage, and get in a taxi.

Traditional methods of process analysis (e.g. process flow diagrams, PERT) can be utilized to understand travelers' procedures when completing these tasks. These methods allow an analyst to explore the steps a passenger must take to complete a task, but do not explore the cognitive steps required. In an airport setting, the cognitive steps are critical to understanding how a passenger uses the facility. The interpretation of signs, facility layout, and procedures by the passenger are all essential the successful completion of each task. In this project, cognitive modeling is used to describe the task process and analyze the traveler's behavior.

Different types of cognitive modeling methods can be applied to model passengers' travel processes. Among them, conceptual maps are useful to describe information procedure but difficult to obtain estimated quantitative values. Mathematic models can provide rigorous predicted values but it takes a long time to construct the models and rigorous values are not widely applicable to all possible

users in an airport setting. Computational models are useful for providing both cognitive procedures and predicted values. Therefore using computational models in the project is reasonable.

Among the cognitive models, EPIC, MHP, and NGOMSL are all considered. “EPIC incorporates many recent theoretical and empirical results about human performance in a computer simulation software framework, and it allows parallel processing at the cognitive stage” [10]. However, EPIC is difficult to apply to multitask models. MHP is another widely applied modeling method. Three subsystems are included in MHP methods: perceptual, motor, and cognitive [12, 13]. However, MHP is highly dependent on researchers' estimations of parameter values and is largely based on theoretical (not empirical) findings. Natural GOMS Language (NGOMSL) is a type of GOMS technique used widely in human-computer interaction area. An important feature of NGOMSL is that it describes how an operator completes a task [14], incorporating both physical and cognitive steps.

4.2 Results

Each scenario was modeled using NGOMSL, as shown in Appendix A. The three models each contain a set of assumptions about how a passenger would complete the scenario. The length and complexity of each model is varied based on the number of steps required of the passenger.

5.0 Model Validation

5.1 Methodology

Focus groups were conducted to validate the mental models after they were created. In the models the decision points and processes need to be validated. Decision points represent the steps in the models where a traveler makes decisions or has choices.

In total, six focus groups were conducted and 22 frequent fliers participated in the groups. Frequent fliers are defined as the people who have been a passenger on a commercial flight more than five times in the past three years. Each focus group lasted 40-60 minutes with 2-6 participants in each group. Each focus group had four discussion components. First, participants were asked to describe their favorite airport and to share both good and bad travel experiences. The purpose of this component was to have participants recall past trips and to spark ideas regarding airport design. The second component of the focus groups was discussion regarding the three scenarios. Participants were asked how they would complete each scenario, with the intent of using their responses to validate the NGOMSL scripts. Third, participants were asked about specific airport design features (e.g. signs, layout) that either improve or hinder their travel experience. Finally, participants were asked summary questions regarding their role and perceptions as a passenger. Each focus group component consisted of multiple questions that were posed to the participants. The discussion in the focus groups were recorded and analyzed.

The data was first transcribed and then coded according to the four levels shown in Table 1 using NVIVO 8 software. NVIVO 8 is data analysis software for qualitative data. In this project, audio

recordings, transcripts of focus groups were all analyzed in this software. The first level describes what scenario was being discussed during the focus group. The second level identifies a specific process within the scenario. The third level describes airport features, while the fourth level defines any user actions discussed in the focus group. The coding of the transcribed data into these four levels allowed for improved analysis by matching the focus group results with the NGOMSL models. The first two coding levels are based on the written NGOMSL models and scenarios. The last two coding levels are based on participant statements from the focus groups. For example, a participant statement of " If I see a really big sign that says "Self service kiosk", I'd probably go over there and try" would be coded as scenario 1 (level 1), check bags and print boarding pass (level 2), kiosk (level 3), and look (level 4). The coding allows extraction of similar responses during analysis. For example, all comments related to a kiosk could be extracted by choosing the appropriate level 3 code.

After the transcripts were coded, the data was analyzed for two purposes. First, it was used to verify and revise the NGOMSL models to ensure that each model was complete and accurate in describing passenger behavior. Second, the transcribed data was analyzed to identify airport design features that either hinder or help a passenger during their use of the facility.

Table 1. Coding schema for focus group data analysis

Scenario based coding		Participant feedback coding	
Level 1 (scenario)	Level 2 (process)	Level 3 (feature)	Level 4 (action)
Scenario 1	Go to long term parking	Lane	Look
	Enter long term parking	Parking ticket	Wait
	Park in long term parking lot	Parking lot	Get on
	Retrieve baggage from car	Luggage	Get off
	Locate Main Terminal	Direction	Walk
	Entering Main Terminal	Board	Run
	Retrieve the name of airline	Ticket	Read
	Getting direction to airline counter	Shuttle	Talk
	Check bags and print boarding pass	Counters	Ask
	Go through security	Kiosk	
	Find the concourse	Staff	
	Find the departure gate	Queue	
	Board	Airline name	
	Scenario 2	Exit arrival gate	Crowd
Check for gate information		Carousel	
Go to rail station		Doors	
Take rail to concourse A		Flight number	
Go to departure gate		Route sign	
Scenario 3	Exit arrival gate	Location sign	
	Walk to luggage claim area		
	Take luggage		
	Walk to the taxi waiting area		
	Take a taxi		

5.2 Validation Results

Each NGOMSL script was analyzed based on the responses from the focus group participants. Within each NGOMSL script, methods are used to describe the steps a passenger takes to complete the scenario. The validation results, shown in Appendix B, are categorized based on each model's methods. In Appendix B, the number of focus group participants who talked about a certain process is represented by "n." For each process that was discussed, a summary of the focus group participants' comments are shown in Appendix B.

Based on the focus group feedback, the NGOMSL models were changed in three places to more accurately represent passenger behavior. First, scenario 1 results demonstrated that travelers did not choose whether to use a kiosk or check-in counter based solely on queue length, but rather relied strongly on personal preference and type of flight. Second, in scenario 1, participants indicated that they looked for their flight number on monitors before looking for directional signs directing them towards their gates. Third, in scenario 2, participants reported that monitors were the primary source for gate information as opposed to other travelers. These three changes have been incorporated into the final NGOMSL models that are shown in Appendix A.

5.3 Additional Design Feature Results

Information about design features in airports was also collected and analyzed. The main focus was on how the frequent travelers perceived the design features in all types of airports. The results of this analysis can be used as a guideline to determine what specific features an airport should emphasize. These results are shown in Appendix C. For each feature, these results include a definition of the feature along with a listing and tallies of both the positive and negative feedback from focus group participants. The amount of feedback received for each design feature is summarized in Table 2.

Table 2. Amount of Design Feature Feedback

Design Feature	Positive Feedback	Negative Feedback
Monitor	13	4
Baggage Carousel	0	10
Check-in Counter	6	2
Crowds	12	14
Location Sign	14	6
Route Sign	4	3
Kiosk	2	12
Staff	15	4

Among the design features, many received much more positive than negative feedback. This includes monitors, check-in counters, location signs, and staff. Focus group feedback focused on the

overall usefulness of each of these features. Participants commented on the use of monitors as the primary source of up to date flight and gate information, which outweighed the negative effects of information overload and confusion. Location signs received a high amount of positive feedback regarding its use as reinforcement for the passengers regarding their current location and progress towards their destination. Other design features received overwhelming negative feedback, including baggage carousel and kiosks. The primary frustration with the baggage carousel was the high levels of crowding around the carousel itself, making it difficult for passengers to locate and retrieve baggage. Negative feedback concerning kiosks centered on poor usability, confusing interfaces, and limited help from staff.

6.0 Facility Site Visits

6.1 Methodology

Site visits were conducted at ten U.S. airports in order to evaluate facility usability according to the validated mental model. The sample of selected airports ranged in date built, size, layout, and passenger transport modes in order to represent a variety of airports that a passenger may encounter in the U.S. Specifically, airports were chosen from three size ranges: small (less than two million passengers per year), medium (between two and eight million passengers per year), and large (more than eight million passengers per year). The number of input ports to the concourse(s) also varied in the chosen airports. For example, some airports have multiple terminals for passengers to enter the facility (e.g. IAH), while other airports have only one main terminal entrance (e.g. ATL). The chosen sample size also included airports with and without a train or light rail system for passenger transport within the facility. While most airports had been renovated within the past ten years, three older airports were included in the sample in order to investigate the impact of build date on facility usability.

The following airports were visited: Golden Triangle Regional Airport (GTR), Hartsfield-Jackson Atlanta International Airport (ATL), Washington Dulles International Airport (IAD), Ronald Reagan Washington National Airport (DCA), Detroit Metropolitan Wayne County Airport (DTW), Memphis International Airport (MEM), Jackson-Evers International Airport (JAN), George Bush Intercontinental Airport (IAH), Denver International Airport (DEN), and William P. Hobby Airport (HOU). The criteria used in selecting these ten airports are shown in Table 3.

Two analysts conducted the site visits and simulated the completion of the three scenarios in the mental model at each airport. One analyst was classified as a novice flyer who had taken less than three flights in the past three years, while the second analyst was a more experienced flyer who had taken approximately twenty flights in the past three years. At each step in the scenarios, observations were recorded concerning any difficulties following the NGOMSL script and key points regarding usability features. Special attention was given to location and route signs, monitors, and the overall layout of the facilities.

Table 3. Selected airports and selection criteria

Airport	Location	Year Built	Year Renovated	Size	Input #	Train
ATL	Atlanta, GA	1928	2006	L	1	Y
DCA	Arlington, VA	1941	1997	L	2	N
DEN	Denver, CO	1995	1995	L	1	Y
DTW	Detroit, MI	1927	2006	L	2	Y
IAD	Chantilly, VA	1962	2010	L	1	Y
IAH	Houston, TX	1969	2005	L	5	Y
HOU	Houston, TX	1937	2010	M	1	N
MEM	Memphis, TN	1930	2004	M	1	N
GTR	Columbus, MS	1971	2010	S	1	N
JAN	Jackson, MS	1963	1997	S	1	N

6.2 Results

Results of the site visits provided insight into tasks in the NGOMSL script that could be problematic for passengers based on the current design of airport facilities. Additionally, the analysts' evaluations indicated that certain airport facilities were notably easier to navigate than others. Appendix D contains the detailed observations from the site visits. The following sections present findings from the site visits based on tasks in the mental model and differences in the airports themselves.

6.2.1 Task-Based Results

Several tasks in the NGOMSL script presented challenges for the analysts to complete. Table 4 lists the tasks that were problematic and the airports where the problems were encountered, as summarized from the observations recorded in Appendix D.

Table 4. Problematic Tasks

	Task	Airports
Scenario 1	Locate ticketing counter	JAN, DCA
	Check bags and print boarding passes	DCA, DEN
	Go through security	GTR, DCA, IAH
Scenario 2	Exit arrival gate	HOU, JAN
Scenario 3	Walk to taxi waiting area	GTR, IAD, DTW

Results suggest that scenario 1, the departing flight, was the most challenging component of the flight experiences. Analysts noted difficulties with scenario 1 in five of the ten airports. Specifically, analysts noted problems with locating the correct airline ticketing counter, checking bags and printing boarding passes, and going through security. Locating the correct ticketing counter at JAN was difficult

because there was a discrepancy in the name of the flight carrier and the parent airline (i.e. United Airlines check-in was handled at the Continental Express counter). At DCA, the correct airline’s ticketing counter was difficult to locate because it was isolated from other airlines’ ticketing counters. Among the other airports visited, a very prominent ticketing area and clearly labeled airline counters were standard. Analysts experienced problems checking bags and printing boarding passes at two airports, primarily due to the use of kiosks. Even though printing boarding passes was primarily handled with kiosks at all ten airports, a small number of airline representatives were present to assist with this task only when passengers had problems using kiosks. At both DCA and DEN, analysts first attempted to use kiosks and resorted to representatives for assistance. Negative comments regarding the task of going through security were recorded for three airports: GTR, DCA, and IAH. At GTR, the confusion surrounded *when* to go through security, because this airport had an atypical protocol for boarding flights. At DCA, analysts had difficulty finding *where* to go through security. A lack of signs led analysts to rely on following the crowd to a security checkpoint. The particularly long queue at the IAH security checkpoint was also noted as a problem. One task in scenario 2, exiting arrival gates, was problematic at multiple airports (HOU and JAN). Immediately upon arrival, passengers must choose a direction from which to exit the arrival gate. Analysts noted that they often resorted to following other passengers in order to determine which direction to go when exiting the gate. Signs directing persons to baggage claim, other gates, restroom facilities, etc. were only visible once outside the gate and in the main hallway. DEN was the only airport where analysts observed a sign from within the gate pointing towards baggage claim and other major destinations.

In scenario 3, the task of walking to the taxi waiting area was problematic at three airports. Analysts noted that at the smallest airport, GTR, there was no designated taxi waiting area. IAD had a designated waiting area for taxis but a lack of prominent signage directing passengers to this area. In DTW, the taxi waiting area was in a separate building from the main terminal where passengers retrieve their luggage. Taxi waiting areas at all other sites were visible from the exit nearest luggage claim. As a result, analysts noted some confusion navigating to the taxi waiting area at DTW.

Results also suggest that current airport design adequately meets passengers’ expectations for a number of tasks in the NGOMSL script. Table 5 summarizes the tasks that analysts had positive comments about at multiple airports.

Table 5. Unproblematic tasks

Scenario	Task	Airports
1	Find concourse	DTW, MEM, ATL, JAN, HOU, DEN
	Find departure gate	DTW, MEM, ATL, JAN, HOU, DEN
2	Go to rail station	ATL, DTW, IAH, DEN
	Take rail to concourse	ATL, DEN
3	Walk to luggage claim	ATL, DTW, JAN, HOU, IAH, DEN

Within scenario 1, tasks of finding the concourse and gate for a departing flight were frequently mentioned with positive comments. Analysts made comments regarding the prominence and

abundance of signs that contributed to the ease of completing these two tasks at six of the ten airports. Observations did not reveal any difficulties locating the correct concourse at the ten airports, and difficulties locating departure gate were only noted at two airports. Among the four airports that had a rail system, analysts recorded no problems locating the rail boarding station or taking the rail to the concourse for a connecting flight. At ATL and DEN, analysts commented on the effectiveness of signs, monitors, and loudspeakers at rail boarding stations. Only at DTW did analysts experience confusion boarding the rail. In scenario 3, the task of walking to luggage claim frequently received positive comments. Comments about luggage claim being “clearly labeled,” “easy to get to,” or something similar, were recorded for six of the ten airports. Negative comments about difficulty locating the luggage claim area were only recorded for one airport (GTR).

6.2.2 Airport-Based Results

In addition to findings regarding specific tasks in the NGOMSL script, results also indicate differences in facility usability based on the airports themselves. Based on analysts’ observations, tasks in the NGOMSL script were easier to complete at some airports than others. A number of positive observations were made regarding usability features at DEN. Positive aspects of the DEN facility include:

- **Extensive use of signs and monitors.** The amount of signage in the DEN facility exceeded any of the other sites visits. Any place in the facility where traffic split into two or more directions, an overhead sign was present to direct passengers. For example, overhead signs were present at the end of each moving sidewalk within concourses, as shown in Figure 1.

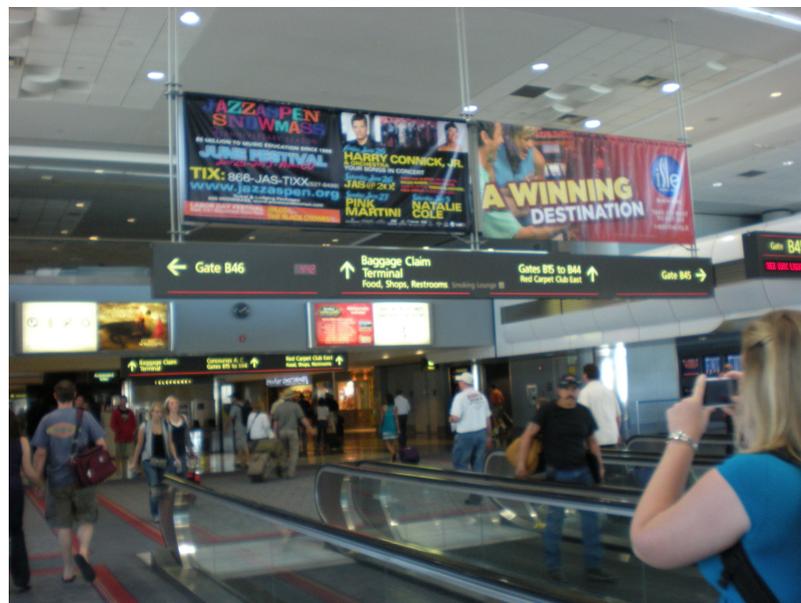


Figure 1. DEN Signs

While typical gate signs include only a concourse label and gate number (e.g. B45), DEN gates listed the departure destination on a digital sign in addition to gate numbers. This was a convenient feature because monitors containing the information of the next departing flight are rarely visible outside of the gate. Additionally, many major overhead signs had the

current local time. This is another convenient feature, especially for passengers traveling from different time zones. Both of these features are documented in Figure 1.

- **Simplistic facility layout.** In spite of its physical size, analysts noted ease in navigating the DEN facility due to its simplistic layout. All terminals were similarly shaped with long, wide concourses. The rail system, with large boarding areas and adequate seating on board, provided rapid transport between terminals. Once within the correct terminal for a departing or connecting flight, all destinations were a straight walk or moving sidewalk ride ahead. Wide hallways within concourses ensured that, even in high traffic areas, the facility never appeared congested.
- **Minimal wait times at ticketing and security.** Analysts noted that there were multiple locations at which passengers could check-in and go through security at DEN. Rather than searching for and identifying the optimal location to complete these tasks themselves, airport staff were helpful in directing passengers to the shortest available queue for both ticketing and security checkpoints. The use of staff to help balance queues was effective in minimizing wait times at both of these tasks.

Similar positive observations were made about usability features at ATL and DTW. The overall layout of the ATL facility was similar to DEN, and both ATL and DTW also had extensive signage and fast transport between concourses or terminals via a rail system. However, analysts noted that in spite of their positive aspects, both ATL and DTW's facilities seemed more congested than DEN. This was most noticeable within concourses, where hallways were not wide enough to accommodate easy traffic flow. Additionally, congestion was observed aboard the rail at ATL and within departure gates at DTW due to inadequate seating at both locations.

In contrast to the highly functional DEN facility, two airports stood out as being less favorable in terms of facility usability: DCA and GTR. At DCA, analysts experienced difficulty completing multiple tasks in the NGOMSL script. In completing the check-in task, analysts entered the facility at an entrance specific to their flight's airline and had difficulty locating a central ticketing area. The check-in location that analysts located was very small (only two kiosks) and nowhere near other ticketing counters. At other sites, ticketing counters were immediately visible from facility entrances on the passenger drop-off level. After completing check-in procedures, analysts were unable to locate signs for security and resulted to following other passengers to the checkpoint. Once beyond security, analysts also experienced difficulty locating the correct concourse and gate. Figure 2 documents the misleading signage that caused analysts difficulty while locating their departure gate. While the sign suggests that gate 18 is straight ahead just beyond gate 17, gate 18 was actually located on the right side of the concourse just beyond gate 16.



Figure 2. Gate signs at DCA concourse

This particular concourse was designed such that seven gates were clustered at the end of the concourse. In addition to the large number of gates for a small area, there were also food and retail vendors mixed among the gates, contributing to congestion in the area. Figure 3 depicts congestion in another DCA concourse due to narrow hallways. Passengers waiting to board a flight at gate 14 were nearly blocking traffic in both directions of this concourse. Wider concourses at other airports allowed some overflow of passengers from within gates while still accommodating the flow of traffic within the concourse.



Figure 3. Concourse congestion at DCA

An additional airport that stood out for its lack of usability features was GTR. Although GTR was the smallest airport visited, analysts noted some confusion competing tasks there due to its lack of signage. The procedure for boarding a plane at GTR is different from larger airports. That is, instead of going through security and waiting at the gate to depart, passengers at GTR wait until approximately 30 minutes before departure to go through security. Signs notifying passengers of non-standard procedures would be helpful for first-time users of the facility. Typical labeling and directional signs were also absent at GTR, so a small amount of searching for areas like baggage claim or restrooms could also be required of first-time users of the facility.

7.0 Design Guidelines

7.1 Signs, Monitors, and Information

- Overhead signs should be present any place where traffic splits into two or more directions (see Figure 4).



Figure 4. Directional Sign

- Monitors with flight information should allow passengers to check for a connecting flight immediately upon exiting their arrival gate while not blocking the flow of traffic (see Figure 5).



Figure 5. Arrival gate flight monitor

- Signs within gates should tell passengers which direction to proceed when exiting the arrival gate (see Figure 6).



Figure 6. Arrival gate exit sign

- Digital gate signs should list the departure location of the next flight in addition to the gate number, because monitors with flight information are not visible until within the gate.
- Monitors should include only the amount of information that can be included on a single display. The use of changing or cycling information on a single monitor should be avoided.

7.2 Facility Layout

- Gates should have ample seating and standing room and an effective layout to avoid overflow of waiting passengers into the walkway.
- Lines for boarding flights should form within the gate rather than outside of the gate, so as to avoid blocking traffic within the concourse.
- If a gate cannot accommodate the number of passengers waiting for a flight, airport staff should be available to redirect waiting passengers and passing pedestrians to avoid walkway congestion.
- To minimize congestion at baggage claim carousels, the visibility of the baggage carousel should be improved. This can be accomplished by installing cameras or mirror systems that allow passengers to see each piece of luggage that is dispensed on the belt. Additionally, the use of multiple dispensing points for the luggage (e.g., opposite ends of a carousel) will help disperse the waiting crowds.
- Airline kiosks should be distributed throughout the airline counter areas to improve pedestrian flow and minimize congestion.

7.3 Other Features, Tasks, and Processes

- Airline representatives should be present at ticketing to assist passengers with kiosks.
- Airline kiosk interfaces should be standardized to improve usability and minimize time required for passengers to check in for a flight. Kiosks should also provide detailed instructions to the passenger after they are checked in for their flight (e.g. proceed to security, go to the counter to check luggage).
- Airport staff should help direct passengers among multiple ticketing areas or security checkpoints to balance queues and minimize passenger wait times.

8.0 Conclusions and Future Work

Utilizing intermodal transportation facilities is often complicated for passengers due to overwhelming processes and a complex facility design. To improve the usability of such facilities, it is critical to understand how passengers use the facilities to complete their tasks. In this project, the passengers' processes were modeled and compared to existing facilities to determine how facility design could be improved. By incorporating a few key design changes, many facilities could drastically improve a passenger's ability to successfully accomplish tasks at the facility. These changes, including modifying signage, layout, and process steps, can lead to increased facility efficiency, effectiveness, and passenger satisfaction.

This project can be expanded in a number of directions. First, additional types of intermodal facilities (e.g. bus terminals, rail stations) can be investigated. Second, the modeling and analysis can be expanded to incorporate a variety of user groups. For example, the NGOMSL model could vary based on

user characteristics such as travel experience, age, and group size. Third, based on the current NGOMSL model, task time can be predicted and compared to empirical task times for further model verification. Finally, the benefit of the suggested design guidelines could be quantified in a future study. This could be done by measuring the differences in efficiency and passenger satisfaction between facilities that have and have not incorporated a selected design feature.

9.0 References

1. Cogan Association (2008), *Innovations for Airport Terminal Facilities*, Airport Cooperative Research Program, ACRP Report 10, Transportation Research Board.
2. Transportation Research Board (TRB) (2000), *Highway Capacity Manual*, National Research Council, Washington, D.C.
3. Fruin, J., (1971), "*Pedestrian Planning and Design*," Metropolitan Association of Urban Designers and Environmental Planners, Inc, New York.
4. Milazzo, Joseph S., Nagui M. Roupail, Joseph E. Hummer, and D. Patrick Allen. (1999), *Quality of Service for Uninterrupted Pedestrian Facilities in the 2000 Highway Capacity Manual*, Transportation Research Board. 1678, 18-24.
5. Roupail, N., J. Hummer, J. Milazzo, II, and D. Allen. (2000), "*Capacity Analysis of Pedestrian and Bicycle Facilities: Recommended Procedures for the Pedestrian Chapter of the Highway Capacity Manual*," Report No. FHWA-RD-98-107, Federal Highway Administration, McLean, VA.
6. Phillips, R., J. Karachepone, and B. Landis. (2001). *Multi-Modal Quality of Service Project*. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.124.8041&rep=rep1&type=pdf>
7. Muraleetharan, T., T. Adachi, T. Hagiwara, S. Kagaya, and K. Uchida. (2004). *Evaluation of Pedestrian Level of Service on Sidewalks and Crosswalks Using Conjoint Analysis*. Transportation Research Board Annual Meeting. Washington D. C.
8. Dixon, L.B. (1996). *Bicycle and Pedestrian Level of Service Performance Measures and Standards for Congestion Management Systems*. Transportation Research Board Annual Meeting. Washington D. C.
9. Benz, G.P. (1986). *Application of the Time-Space Concept to a Transportation Terminal Waiting and Circulation Area*. In Transportation Research Record 1054, TRB, National Academy Press, Washington, DC.
10. Liu, Yili, Feyen, Robert, Tsimhoni, Omer, (2006). *Queuing Network-Model Human Processor (QN-MHP): A computational architecture for multitask performance in human-machine systems*, ACM Transactions on Computer-Human Interaction, 13(1), 37 - 70.
11. Anderson, J. R. & Lebiere, C. (1998). *The Atomic Components of Thought*. Mahwah, NJ: Lawrence Erlbaum Associates.
12. Card K. Stuart, Moran P. Thomas, Newell Allen, (1983), *The psychology of human-computer interaction*, L. Erlbaum Associates Inc. Hillsdale, NJ, USA.
13. Card, S.K; Moran, T. P; and Newell, A. (1986), *The Model Human Processor: An Engineering Model of Human Performance*. In K. R. Boff, L. Kaufman, & J. P. Thomas (Eds.), *Handbook of Perception and Human Performance, Cognitive Processes and Performance*, pages 1–35.
14. Kieras, D. E. (1997). *A Guide to GOMS model usability evaluation using NGOMSL*. In M. Helander, T. Landauer & P. Prabhu (Eds.), *Handbook of human-computer interaction* (2nd ed.; 733–766). Amsterdam: North-Holland.

APPENDIX A

NGOMSL Models

Model Overviews

Assumptions:

1. The investigated task is completed by a solo traveler with a single piece of luggage.
2. No automobile traffic.
3. The user always looks for the largest signs and the most apparent signs, and does not spend time on reading advertisements.

Scenario Descriptions:

Scenario 1

1. The user drives a car on a lane leading to the airport long-term parking lot. Then he judges whether this is the right lane. If not on the right lane the user will change to another lane, if on the right lane, he will drive on.
2. Following the lane he takes the ticket and enters the parking lot.
3. The user drives along the aisle and finds a parking space to park the car.
4. The user gets out of the car, and takes out the baggage from the trunk.
5. The user moves around to look for nearby and apparent signs. Then he reads the words on the sign and tries to find out whether this is the right way to the main terminal. If the sign says he can go directly to the terminal, he will follow the sign to the terminal. If it is a sign saying that he needs to take a shuttle, he will follow the signs with the shuttle's name to the shuttle station, take the shuttle, and get off at the terminal building, and find a way into the building.
6. The user tries to recall the name of airline. If he is not able to recall the name he will take out the ticket and read it.
7. The user moves around and looks for the sign with the airline's name. Then he moves around to find the nearby sign showing the objective counter name. He follows the signs with the airline name and goes to the objective counter.
8. The user goes to the counter, takes out the ticket and waits for the representative to print out the boarding pass and get the bags checked in.
9. The user moves around to look for the sign to the security checkpoint and follows the sign to that location. He stands in the queue and goes through the security check.
10. The user recalls the name of the concourse where he needs to go and finds a nearby sign to the concourse. He follows the signs with the objective concourse name and goes to the objective concourse.
11. The user recalls the name of objective gate. Then he moves around to find the nearby sign showing the objective gate name. He follows the signs with the objective gate name and goes to the objective gate.
12. The user waits at the gate until he boards the plane at the right time.

Scenario 2

1. The traveler moves out of the arrival gate following other travelers to the concourse.
2. The traveler moves around to find the sign to show the way to railway station and then moves following the indicated way to the destination.
3. The traveler moves to the station and looks for the train he will take. Then he travels to the right platform and waits for the train. When the train comes he gets on it. He takes the train and gets off at the destination of the concourse.
4. The traveler moves around to find the way to the destination gate. Then he locates the right sign and follows its direction and moves to the gate.

Scenario 3

1. The traveler moves out of the arrival gate following other travelers to the concourse.
2. The traveler moves around to find the sign to show the way to luggage claim area, and then moves following the indicated way to the destination.
3. The traveler moves to the conveyor that carries the luggage from his flight and waits for his own luggage. Then when the luggage shows up he takes it off the conveyor.
4. The traveler moves around to find the way to taxi area. Then he finds it and goes through the door to the taxi waiting area.
5. The traveler waits for a taxi. When a taxi comes he puts his luggage in the trunk of the car.

NGOMSL Model - Scenario 1

Drive to airport, park the car in long-term parking, go to ticket counter representative or Kiosk to check in for flight, check bags, proceed through security, and proceed to your departure gate.

Method to Accomplish Goal: Scenario 1

- Step 1. Accomplish Goal: Go to long term parking
- Step 2. Accomplish Goal: Enter long term parking
- Step 3. Accomplish Goal: Park in long term parking lot
- Step 4. Accomplish Goal: Retrieve baggage from car
- Step 5. Accomplish Goal: Locate Main Terminal
Accomplish Goal: Entering Main Terminal
- Step 6. Accomplish Goal: Recall the name of airline
Accomplish Goal: Recall the airline name
- Step 7. Accomplish Goal: Check bags and print boarding pass
- Step 8. Accomplish Goal: Go through security
- Step 9. Accomplish Goal: Find the concourse
- Step 10. Accomplish Goal: Find the departure gate
- Step 11. Accomplish Goal: Board
- Step 12. Return with goal accomplished

- 1) Method to accomplish goal of looking for the car in long term parking lot
 - Step 01: Retrieve-LTM that the desired lane is LANE to long term parking lot
 - Step 02: Select a lane to drive on
 - Step 03: Look at the sign above and retain as LANE_CURRENT
 - Step 04: Decide: If LANE_CURRENT is not LANE, then go to 02
 - Step 05: Follow the lane to long term parking lot
 - Step 06: Forget LANE and LANE_CURRENT and report goal accomplished

- 2) Method to accomplish goal of entering long term parking lot gate
 - Step 01: Approach ticket machine
 - Step 02: Read the instructions on the machine
 - Step 03: Press the button to choose long term parking
 - Step 04: Read screen about where to take the ticket
 - Step 05: Take out the ticket
 - Step 06: Drive past the gate
 - Step 07: Report goal accomplished

- 3) Method to accomplish goal of parking in long term parking
 - Step 01: Drive along aisle following signs
 - Step 02: Decide: If the next parking lot besides the aisle is full, then go to 1
 - Step 03: Park the car
 - Step 04: Report goal accomplished

- 4) Method to accomplish goal of retrieving luggage from car
 - Step 01: Get out of the car
 - Step 02: Open the trunk
 - Step 03: Take the luggage out of the trunk
 - Step 04: Report goal accomplished

- 5) Method to accomplish goal of locating Main Terminal
 - Step 01: Move on to look for a nearby sign
 - Step 02: Read the words on the sign and retain as SIGN-MAIN
 - Selection rule set for goal of entering Main terminal*
 - If SIGN-MAIN is Main Terminal, then accomplish goal of walking to Main Terminal*
 - If SIGN-MAIN is Shuttle to Main Terminal, then accomplish goal of taking a shuttle to Main Terminal*
 - Report goal accomplished

- 5a) Method to accomplish goal of walking to Main Terminal
 - Step 01: Start moving towards the main building
 - Step 02: Recall SIGN-MAIN
 - Step 03: Move around and look for a nearby sign

Step 04: Read the words on front sign and retain as SIGN-NEARBY
Step 05: Decide: if SIGN-NEARBY is different from SIGN-MAIN then forget SIGN-NEARBY and go to 02
Step 06: Read the signs and move in indicated direction
Step 07: Enter the door
Step 08: Forget SIGN-MAIN and report goal accomplished

5b) Method to accomplish goal of taking a shuttle to Main Terminal

Step 01: Step 01: Recall "SIGN-MAIN"
Step 02: Move around to look for a nearby sign
Step 03: Read the sign nearby and retain the words as SIGN-NEARBY
Step 04: Decide: if SIGN-NEARBY is different from SIGN-MAIN then forget SIGN-NEARBY and go to 01
Step 05: Read the signs and move in indicated direction
Step 06: Get the shuttle station and wait
Step 07: Get on the shuttle and wait
Step 08: Get off the shuttle
Step 09: Enter the door
Step 10: Forget SIGN-MAIN and report goal accomplished

6) Method to accomplish goal of recalling the name of Airline

Step 01: Retrieve LTM that the airline name is AIRLINE
Selection rule set for goal of recalling the airline name
If AIRLINE is Blank, then accomplish goal of reading ticket
If AIRLINE is AIR, then accomplish goal of recalling airline name
Report goal accomplished

6a) Method to accomplish goal of reading ticket

Step 01: Take out the ticket and read the name of airline and retain as AIR
Step 02: Forget AIRLINE and report goal accomplished

6b) Method to accomplish goal of recalling airline name

Step 01: Recall AIR
Step 02: Report goal accomplished

7) Method to accomplish goal of getting directions to airline counter

Step 01: Recall AIR
Step 02: Move around and look for a nearby sign
Step 03: Read the words on the nearby sign and retain as SIGN-COUNTER
Step 04: Decide: if SIGN-COUNTER is different from AIR then forget SIGN-COUNTER and go to 02
Step 05: Read the signs and move in indicated direction
Step 06: Read the sign on the counter and retain it as COUNTER
Step 07: Decide: if COUNTER is the different with AIR then forget COUNTER and go to 02
Step 08: Forget SIGN-COUNTER and COUNTER and report goal accomplished

- 8) Method to accomplish goal of checking bags and print boarding pass
- Step 01: Approach airline counters
 - Step 02: Count the number of people in queues in front of kiosk and retain as N
 - Step 03: Count the number of people in queues in front of counter and retain as N'
 - Selection rule set for goal of choosing the check in for flight*
 - If $N > N'$, then accomplish goal of checking in at counter*
 - If $N < N'$, then accomplish goal of checking in at kiosk*
 - Report goal accomplished
- 8a) Method to accomplish goal of checking in at counter
- (Step 01: Take out the ticket)
 - Step 02: Enter the queue at counter
 - Step 03: Wait in queue
 - Step 04: Hand in the ticket and ID to the agent
 - Step 05: Wait for printing of boarding pass and check in bags
 - Step 06: Report goal accomplished
- 8b) Method to accomplish goal of checking in at kiosk
- Step 01: Take out the ticket
 - Step 02: Enter the queue at kiosk
 - Step 03: Wait in queue
 - Step 04: Slide ID and ticket to get boarding pass
 - Step 05: Wait for printing of boarding pass and check in bags
 - Step 06: Report goal accomplished
- 9) Method to accomplish goal of going through security
- Step 01: Recall SECURITY
 - Step 02: Move around and look for a nearby sign
 - Step 03: Read the words on the nearby sign and retain as SIGN-SECURITY
 - Step 04: Decide: if SIGN-SECURITY is different from SECURITY then forget SIGN-SECURITY and go to 02
 - Step 05: Stand in a queue
 - Step 07: Go through the queue and get inspected
 - Step 08: Report goal accomplished
- 10) Method to accomplish goal of finding the concourse
- Step 01: Retrieve LTM that the objective sign is CONCOURSE-A
 - Step 02: Move around to find a nearby sign
 - Step 03: Read the words on closest sign and retain as CONCOURSE-NEARBY
 - Step 04: Decide: if Closet Sign is different from for the CONCOURSE-A, then forget CONCOURSE-NEARBY and go to 02
 - Step 05: Follow the directions on the sign and move towards the concourse
 - Step 06: Forget CONCOURSE-NEARBY and report goal accomplished

- 11) Method to accomplish goal of finding the departure gate
 - Step 01: Look at the monitors ahead and retain the objective gate is G
 - Step 02: Move around and look for a nearby sign
 - Step 03: Read the words on the nearby sign and retain as SIGN-GATE
 - Step 04: Decide: if SIGN-GATE is different from G then forget SIGN-GATE and go to 02
 - Step 05: Follow the directions and move to the gate
 - Step 06: Forget SIGN-GATE and G and report goal accomplished

- 12) Method to accomplish goal of boarding
 - Step 01: Retrieve LTM that the boarding time is A
 - Step 02: Read the boarding time on Monitor and retain as TIME
 - Step 03: Decide: if TIME is later than A, then forget TIME and go to 02
 - Step 04: Board

NGOMSL Model - Scenario 2

Disembark plane, check departure gate, walk to inside airport rail, take inside rail to concourse A, exit rail and walk to departure gate

Method to Accomplish Goal: Scenario 2

- Step 1. Accomplish Goal: Exit arrival gate
 - Step 2. Accomplish Goal: Check for gate information
 - Step 3. Accomplish Goal: Go to rail station
 - Step 4. Accomplish Goal: Take rail to concourse A
 - Step 5. Accomplish Goal: Go to departure gate
 - Step 6. Return with goal accomplished
-
- 1) Method to accomplish goal of exiting arrival gate
 - Step 01: Move out of the arrival gate following other travelers
 - Step 02: Report goal accomplished

 - 2) Method to accomplish goal of checking for gate information
 - Step 01: Move around and look for a nearby monitor
 - Step 02: Read the words on front monitor and retain as SIGN-NEARBY
 - Step 03: Decide: If SIGN-NEARBY is not about flight gate, then forget SIGN-NEARBY and go to 01
 - Step 04: Read the words and retain as Gate-G and Concourse-A
 - Step 05: Forget SIGN-NEAEBY and report goal accomplished

 - 3) Method to accomplish goal of going to rail station
 - Step 01: Retrieve-LTM that the destination is RAIL-STATION

- Step 02: Move around and look for a nearby sign
- Step 03: Read the words on front sign and retain as SIGN-NEARBY
- Step 04: Decide: If SIGN-NEARBY is not RAIL-STATION, then forget SIGN-NEARBY and go to 02
- Step 05: Move in indicated direction
- Step 06: Forget RAIL-STATION and report goal accomplished

4) Method to accomplish goal of taking rail to CONCOURSE-A

- Step 01: Move around and look at the nearby sign on at the station
- Step 02: Read the words on the sign and retain as CONCOURSE-A
- Step 03: Move around and look at the sign at the nearby platform
- Step 04: Read the words on the sign and retain as CONCOURSE
- Step 05: Decide: If CONCOURSE is not CONCOURSE-A, then forget CONCOURSE and go to 03
- Step 06: Stop and wait at the platform to CONCOURSE-A
- Step 07: Get on the train to CONCOURSE-A
- Step 08: Get off the train
- Step 09: Forget CONCOURSE-A and report goal accomplished

5) Method to accomplish goal of finding the departure gate

- Step 01: Retrieve LTM that the objective sign is GATE-G
- Step 02: Move around and look for a nearby sign
- Step 03: Read the words on the nearby sign and retain as SIGN-GATE
- Step 04: Decide: if SIGN-GATE is different from GATE-G then forget SIGN-GATE and go to 02
- Step 05: Follow the directions and move to the gate
- Step 06: Forget SIGN-GATE and report goal accomplished

NGOMSL Model - Scenario 3

Disembark from plane, claim luggage, and get in a taxi.

Method to Accomplish Goal: Scenario 3

- Step 1. Accomplish Goal: Exit arrival gate
- Step 2. Accomplish Goal: Walk to luggage claim area
- Step 3. Accomplish Goal: Take luggage
- Step 4. Accomplish Goal: Walk to the taxi waiting area
- Step 5. Accomplish Goal: Take a taxi
- Step 6. Return with goal accomplished

1) Method to accomplish goal of exiting arrival gate

- Step 01: Move out of the arrival gate following other travelers

Step 02: Report goal accomplished

2) Method to accomplish goal of walking to luggage claim area

Step 01: Retrieve-LTM that the destination is LUGGAGE-CLAIM

Step 02: Move around and look for a nearby sign

Step 03: Read the words on front sign and retain as SIGN-NEARBY

Step 04: Decide: If SIGN-NEARBY is not LUGGAGE CLAIM, then forget SIGN-NEARBY and go to 02

Step 05: Move in indicated direction

Step 06: Forget LUGGAGE-CLAIM and report goal accomplished

3) Method to accomplish goal of taking luggage

Step 01: Retrieve-LTM that the flight number is NUMBER

Step 02: Move around and look at the nearby monitor above the baggage carousel

Step 03: Read the words on the monitor and retain as BOARD-NEARBY

Step 04: Decide: If BOARD-NEARBY is not NUMBER, then forget BOARD-NEARBY and go to 02

Step 05: Walk closed to the belt and wait

Step 06: Identify the luggage

Step 07: Take off the luggage

Step 08: Forget NUMBER and report goal accomplished

4) Method to accomplish goal of walking to the taxi waiting area

Step 01: Retrieve-LTM that the name is TAXI

Step 02: Move around and look at a nearby sign

Step 03: Read the words on the sign and retain as BOARD-NEARBY

Step 04: Decide: If BOARD-NEARBY is not TAXI, then forget BOARD-NEARBY and go to 02

Step 05: Exit the door with the name of TAXI at the top of the door

Step 06: Forget TAXI and report goal accomplished

5) Method to accomplish goal of taking a taxi

Step 01: Recall TAXI

Step 02: Move around and look at a nearby a monitor

Step 03: Read the words on the monitor and retain as BOARD-NEARBY

Step 04: Decide: If BOARD-NEARBY is not TAXI, then forget BOARD-NEARBY and go to 02

Step 05: Go to the station and wait

Step 06: Put luggage into the trunk of a taxi

Step 07: Get on the taxi

Step 08: Forget TAXI and report goal accomplished

APPENDIX B

Focus Group Results – Model Validation

Six focus groups were conducted and the three scenarios were examined. The results are summarized here. The number in parentheses (n) indicates the number of people who had talked about this exact topic. The NGOMSL model was modified based on these feedback.

Scenario 1

Method 1-Go to long term parking (n=4)

- In step 3 four participants report they would follow the signs.

Method 2-Enter long term parking (n=0)

Method 3-Park in long term parking lot (n=0)

Method 4-Retrieve baggage from car (n=0)

Method 5- Locate Main Terminal (n=3)

- Three participants report they would wander around to look for signs.

Method 5a-Walk to Main Terminal (n=11)

- 11 participants would look for main terminal first by signs.

Method 5b-Take a shuttle to Main Terminal (n=2)

- If they cannot find the terminal, 2 ask staffs or other people where the terminal is.

Method 6-Retrieve the name of Airline (n=0)

Method 7-Get directions to airline counter (n=1)

- One participant said he looked up to find monitors.

Method 8-Check bags and print boarding pass (n=15)

- 4 participants choose according to the line length. 6 people prefer kiosk, even the line is long, since usually counters are full of people with kids. 5 people prefer counter just because of their habit. The kiosk cannot check in international flights.

Method 8a- Check in at counter (n=0)

Method 8b- Check in at kiosk (n=0)

Method 9- Go through security (n=1)

- In security one participant suggest that people need to take laptops out to save the efforts of rescanning.

Method 10-Find the concourse (n=0)

- Should be very similar to Method 7, 11.

Method 11-Find the departure gate (n=14)

- 5 people looked at the monitors to find the flight number and 4 people followed signs to find their gates. 5 people also mentioned they would ask staffs or other passengers to find the gate.

Method 12 –Boarding (n=6)

- Participants mostly talked about their activities during the waiting for boarding, such as surfing Internet, talking to people and reading.

Scenario 2

Method 1-Exit arrival gate (n=0)

Method 2-Check for gate information (n=13)

- Usually people (ten of them) looked at the monitors to find direction information. Three participants mentioned they would follow people.

Method 3-Go to rail station (n=9)

- Eight of participants said they look at signs to find where the railway station is, while only one said he would ask a person.
- The signs location can be over head.

Method 4-Take rail to concourse A (n=5)

- Five participants talked about their experiences of taking wrong trains, which reveals the getting on trains procedure.

Method 5-Go to departure gate (n=10)

- Nine participants mentioned they would follow the signs, and among the ten participants, four mentioned they would count the gate numbers. Only one person said she would follow people.

Scenario 3

Method 1-Exit arrival gate (n=0)

Method 2-Walk to luggage claim area (n=10)

- Seven people said they would look for signs to the baggage claim area, and three said they would follow the crowds.

Method 3-Take luggage (n=16)

- Six of the participants reported they looked at the signs and 3 participants reported they followed people while other people did not talk what exactly they are looking for.

Method 4-Walk to the taxi waiting area(n=0)

Method5-Take a taxi (n=12)

- Four of the participants said they walked directly outside to look for the taxi since it would be more obvious. Six followed signs, two participants mentioned they asked the staffs.

APPENDIX C

Focus Group Results – Design Features

Six focus groups were conducted and various design features were examined. The results are summarized here. The number in parentheses (n) indicates the number of people who had talked about this exact topic.

1. Monitor

In the focus group, participants kept talking about looking at monitors to look for flight information, departure gate and so on. The monitor appears in the following situations: to check gate number, to check the changes of flight, to find flights of luggage, to look for flight number.

- Good: From the focus group monitors can reflect the updated status of flights therefore the travelers are relying on them to obtain the information of changes of gates and time (n= 13).
- Bad: Information can be overwhelming in monitors since in a monitor too many flights are displayed (n= 2). Certain monitors also rotate flight information which leads to travelers' frustration (n= 2).

2. Carousel

Baggage carousel appears in the following situation: travelers take luggage.

- Good: N/A
- Bad: Too many people around carousel make it difficult to take luggage in time (n=7). Children also can be a problem for taking luggage off the carousel when they are around (n= 3).

3. Counters

Counter means the counter where staffs stay for checking in luggage. Counter appears in the following situation: to check in luggage.

- Good: check-in counters can serve international travelers while kiosk cannot (n=3). It is also easy for travelers to change window seats. Counters can help with the travelers who are not used to kiosks (n= 3).
- Bad: Sometimes lines in front of counters are too long (n=2).

4. Crowds

Crowds mean crowds of people waiting or walking around a passenger. Crowds appear in the following situations: to look for a gate, to check in luggage, to go to taxi area, to go to a certain gate, to exit a flight.

- Good: Crowds can be followed when a traveler just gets off a flight and continues with a connection flight (n= 4). In other situations to find a certain destination such as luggage claim area and ground transportation area (n=8).

- Bad: Sometimes lines in front of check-in counters are too long (n=2). Crowds of people also prevent a traveler to take off luggage from luggage carousel in time (n=9). It is difficult for a traveler to move fast if s/he is in a hurry for a flight (n=3).

5. Location sign

Location sign means the sign that shows where a certain place is, such as the sign for gate number, or the sign for “restroom”. Location signs appear in the following situations: to look for a gate, to check in luggage, to go to taxi area, to go to a certain gate, to exit a flight. Travelers look overhead and around to look for location signs.

- Good: Location sign is very important for travelers to locate their destinations (n=14). Most of the time only when a traveler see a sign, s/he knows whether s/he arrives at the destination (n=14). Signs are used in all the scenarios in the focus group.
- Bad: The design of a location sign can be inconvenient for travelers (n=2). Sometimes there is a lack of sign so that travelers can lose themselves in the airport (n=2). Participants in the focus group suggest more signs are helpful (n=2).

6. Route sign

Route sign means the sign that a traveler can follow to a destination, for example, the name of a place with an arrow, or “To Terminal A”. Route signs appear in the following situations: to look for a gate, to check in luggage, to go to taxi area, to go to a certain gate, to exit a flight. Travelers look overhead and around to look for location signs.

- Good: Travelers knows the directions according to the signs (n=4).
- Bad: a participant suggests she prefer south/north instead of left/right for route signs (n=1). Too many signs together can make it difficult for travelers to follow (n=2).

7. Kiosk

Kiosk means the self check in machines that travelers can check in luggage and print boarding pass by themselves. Kiosk appears in the following situation: check in luggage

- Good: A Kiosk can be fast for travelers who only have carryon bags (n=2).
- Bad: Travelers often run into troubles with the operation of kiosks (n=4). International flights cannot be checked in with kiosks (n=3). Travelers do not always trust in kiosks and they prefer to have staffs to be around to help (n=5).

8. Staff

Staff means the people who stay for services such as answering questions, checking in luggage and boarding passengers in the airport. Staffs appear in the following situations: to look for a gate, to check in luggage, to go to taxi area, to go to a certain gate, to exit a flight. Travelers look overhead and around to look for location signs.

- Good: staffs are the ones that travelers rely on once they have problems with the use of kiosks, finding directions and so on (n= 15).
- Bad: Participants suggest having more staffs in the airport to answer their questions and help them when they are in trouble (n=4).

APPENDIX D

Facility Site Visit Results

Airport: Denver (DEN)

Scenario: 1

Step		Complete?	Comments**
1	Go to long term parking		<i>Took hotel shuttle (~10 mi.)</i>
2	Enter long term parking		<i>Road signs for East and West terminals leading into airport with which airlines. Too many airlines on the sign to read in passing</i>
3	Park in long term parking lot		
4	Retrieve baggage from car	Yes	<u>Took a shuttle</u>
5	Locate Main Terminal	Yes	<u>Two main terminals depending on flight airline (East and West terminal).</u> <i>Shuttle dropped off at Terminal West for Southwest flights.</i>
6	Enter Main terminal	Yes	<i>Entered at baggage claim level. Followed signs to ticketing. "On floor 6." Slightly confusing because it seemed we arrived on bottom floor. Ticketing was one floor above.</i>
7	Retrieve name of airline	Yes	<u>Know before you enter the airport to determine which terminal to enter.</u> <i>Large southwest check-in area. Overhead monitors at counter for boarding passes only vs. bag check. Had to read signs before entering line to ensure you were in the right line. Kiosks at counter and 3 reps checking bags.</i>
8	Check in bags and print boarding pass		<u>Would not let us check in at a kiosk (something might have been wrong with our number or something) had to go to the rep outside (rep was shorter).</u> <i>Rep standing at line entrances directing people outside to curbside check-in with no line. 2 reps at curbside, no kiosks.</i>
9	Go through security	Yes	<u>2 security entrances; North and South.</u>
10	Find the concourse	Yes	<u>Easy to get to - had to take a train.</u> <i>Within security, followed signs to our terminal. Had to take train.</i>
11	Find the departure gate	Yes	<u>In a cramped area.</u> <i>Digital signs along with gate number had departing to location. Monitors at gates were clear. Plenty of seating.</i>
12	Board	Yes	

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Denver (DEN)

Scenario: 2

	Step	Complete?	Comments
1	Exit arrival gate		<i>Immediately noticed sign/arrow to baggage claim at gate exit. Nice not to have to stop and look right or left.</i>
2	Check for gate information	Yes	<u>Easy to find right off gate exit.</u> <i>Found monitors within a few feet of gate with flight/gate info.</i>
3	Go to rail station	Yes	<i>Followed signs down to board train. Signs read "train to ACD." Digital signs at boarding area tell you which side to board according to where you want to go.</i>
4	Take rail to concourse A	Yes	<u>Only way to get to other concourse was to take a train; a lot of times they offer a way to walk there.</u> <i>Loudspeaker on train tells when to exit. When exit rail, signs on wall with current location.</i>
5	Go to departure gate	Yes	<i>Followed signs up escalator to "C gates." Atrium allows you to be able to see what is on other floors.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Denver (DEN)

Scenario: 3

Step		Complete?	Comments
1	Exit arrival gate	Yes	<u>Liked that there was a sign right as we exited the gate that said to baggage claim.</u> <i>Immediately noticed sign/arrow to baggage claim at gate exit. Nice not to have to stop and look right or left.</i>
2	Walk to luggage claim area	Yes	<u>Easy to get to; well labeled.</u> <i>Used moving sidewalks to follow signs through concourse towards baggage claim. Rode train from Terminal B to main terminal.</i>
3	Take luggage	Yes	<i>Very tall signs with which airlines for which baggage claim (E vs. W). Followed signs for United and found flight on monitor with carousel number.</i>
4	Walk to the taxi waiting area	Yes	<u>Easy to get to; well labeled.</u> <i>Different types of transportation on different "islands." Island signs had taxi company names instead of just "taxi," which is confusing if you aren't familiar with company names.</i>
5	Take a taxi		<u>took a shuttle;</u> <i>Took hotel shuttle instead.</i>
---	Additional Notes	---	Most large signs had current local time. Whole airport seemed modern.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Golden Triangle Regional Airport (GTR) Scenario: 1

Step		Complete?	Comments
1	Go to long term parking	Yes	<u>There were not any signs that said long term parking; it was just assumed that was where one would park because there was nowhere else, and it was behind a gate; No signs in parking lot. Only one gate/ lane to lot.</u>
2	Enter long term parking	Yes	<u>Nothing said long term parking, just guessed that the area we went in was the right area; Ticket machine had prices per length of stay; distributed stub.</u>
3	Park in long term parking lot	Yes	<i>One directional parking. Parked in first available slot (front row).</i>
4	Retrieve baggage from car	Yes	
5	Locate Main Terminal	Yes	<u>No signs that said main terminal, or to where a check in area would be. There is only one entrance to the airport, so assumed to go through the doors, and we will figure it out inside. Single building was visible from parking lot.</u>
6	Enter Main terminal	Yes	<u>When we walked though the main entrance, we had to look around a little to find where to check in; Only one entrance.</u>
7	Retrieve name of airline	Yes	<i>Delta is the only airline out of GTR; Only one ticket counter/ two kiosks. Representative assisted us when we approached the ticket counter. There was no queue.</i>
8	Check in bags and print boarding pass	Yes	<u>Quick and easy, only one desk to check in at but there were 2 kiosks to get a boarding pass; I did not check bags. Representative gave boarding pass.</u>
9	Go through security	Yes	<u>Didn't go though security until about 30 min before the flight was scheduled to leave; Had to wait approximately 30 mints before boarding time to go through security. Past security was the actual gate waiting area.</u>
10	Find the concourse	Yes	<u>Only one gate to leave out of, we were in the waiting area before going though the security; Note: found concourse before going through security.</u>
11	Find the departure gate	Yes	<u>Only one gate and it was not well labeled for a first time flyer. * Once beyond security, there appeared to be only one gate. Large waiting area (larger than other airports).</u>
12	Board	Yes	<u>Representative. Called for passengers to board.</u>

Additional Comments:

* When we were sitting in the waiting room before we could go though security, I think there was a first time flyer our of GTR because he seemed to be a little confused as to what to do. We were not instructed by anyone that we were to wait before we went through security. There were no signs that instructed us where to go; we just followed what other people were doing.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Golden Triangle Regional Airport (GTR)

Scenario: 3

Step		Complete?	Comments
1	Exit arrival gate	Yes	
2	Walk to luggage claim area	Yes	<u>Was not labeled where to go to get to the baggage claim. We just followed where others went. Since the airport was so small, it was easy just to look around and find the area, but for a first time flyer into GTR, it could be a little confusing without having anything really labeled; No prominent signs for baggage claim, but crowd was headed there.</u>
3	Take luggage	Yes	<i>Only one carousel, so no monitor to identify which flight luggage was from.</i>
4	Walk to the taxi waiting area	Yes	<u>There is not real taxi area. But there was one outside the airport; No signs for taxis, but one was waiting outside airport entrance. Walked to car in parking lot.</u>
5	Take a taxi		

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Atlanta (ATL)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking	No	
2	Enter long term parking	No	
3	Park in long term parking lot	No	NOTE: We were not able to completely leave the airport and see the long term parking area (transfer airport), or the ticketing area. We had exited through the baggage claim and were able to enter through the claim, but it lead directly to the main security area.
4	Retrieve baggage from car	No	
5	Locate Main Terminal	No	<i>No sign for "Main Terminal" but assumed signs to baggage claim/ticketing would lead there. Rode rail from concourse E to T, then walked to main terminal from T-- short walk.</i>
6	Enter Main terminal	No	<i>Exited rail and followed signs for baggage claim/ground transportation. Signs were not labeled "Main Terminal," rather they directed you to things in the main terminal-- ticketing/baggage claim/ ground transportation.</i>
7	Retrieve name of airline	No	
8	Check in bags and print boarding pass	No	
9	Go through security	Yes	<u>Even though we entered though the baggage claim area, we were able to return into the concourses though the main security area.</u> <i>At main terminal entrance from taxi area, followed signs for "All gates". Security area was roped off. Very large security checkpoint-- seemed to be one for entire airport. One long queue split into several scanners. One luggage scanner per body scanner. No signs for directions about what to do at checkpoint until you reached front of queue.</i>
10	Find the concourse	Yes	<u>Everything was clearly labeled and easy to follow.</u> <i>Beyond security checkpoint, followed signs for Concourse E. Rode escalator down to board rail again. Rode rail to Concourse E.</i>
11	Find the departure gate	Yes	<i>Everything was clearly labeled and easy to follow, had flight information all throughout the concourses. Exited rail and went upstairs again to Concourse E. Followed overhead signs leading to our gate number.</i>
12	Board	Yes	<i>Gate was clearly labeled. Monitor was large enough that you could see flight information from seating within gate.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Atlanta (ATL)

Scenario: 2

Step		Complete?	Comments**
1	Exit arrival gate	Yes	<u>As we left the gate, there was a screen that had all the transfer gate numbers for the people on the flight. It unfortunately did not have our flight information on it (or we just misread it);</u> <i>When exited gate, representative directing passengers to look at monitor with flight info. Monitor was inside of gate.</i>
2	Check for gate information	Yes	<u>Had to look at the larger departure screens for our flight information, but we did not see our connecting flight information. We had to ask a gate person for assistance to where our connection gate number was going to be.</u> * <i>Our flight was not on monitor inside gate (earlier Dulles flight was). Walked out of gate to wall with dozen or so monitors and still didn't see flight. Asked Delta representative. At nearest gate, he told us gate E31. We were in concourse D, so followed signs to "E gates." While following signs, passed rail boarding station with sign that said "to Concourse E". Rode rail it was in EXX.</i>
3	Go to rail station	Yes	<u>Well labeled by overhead signs;</u> <i>Followed signs to concourse E. Signs led to Rail boarding area. Sign at rail station had current area and where rail was going next and general terminal map.</i>
4	Take rail to concourse A	Yes	<u>It is a great way to get to concourse to concourse, but there was not enough seating or something to hold on to for all the people that were getting onto the rail system.</u> <i>Rode rail to Concourse E. Signs inside rail had "Next stop Concourse E." Loudspeaker confirmed next stop and told us where we were when we stopped.</i>
5	Go to departure gate	Yes	<u>Well labeled by signs. Once there our gate had a screen that showed the destination and departure time, and if it was on schedule or not.</u> <i>Immediately when we exited rail, sign on wall for "Concourse E". Arrows directed traffic to concourse E up one floor via escalator. We didn't have gate number on boarding pass, so we had to memorize it. (Also wasn't posted on monitors yet).</i>

Additional Comments:

* A reason that our flight information was not on the main boards was because our flight left later in the day, whereas the flights that were on the board were the more recent ones. Atlanta is the busiest airport in the United States, so there might not be enough room to put every flight onto the main board; they just have to update it throughout the day.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Atlanta (ATL)

Scenario: 3

Step		Complete?	Comments
1	Exit arrival gate	Yes	<i>Followed signs for baggage claim. While following signs, rail boarding station had signs that told us to take the rail to baggage claim. Would have been a very long walk to baggage claim, signs didn't necessarily say that.</i>
2	Walk to luggage claim area	Yes	<u>Clearly labeled, had to take a shuttle to get to baggage claim.</u> <i>Took rail to baggage claim area. After we got off rail, followed signs leading up escalator/elevator one floor to baggage. Large sign atop elevator directed you to direction for your airline's carousels. Groups of monitors had flight info/carousel number. Found our flight easily on the monitor, identified carousel 10. Carousel numbers large and visible.</i>
3	Take luggage	Yes	<u>Each baggage claim had a monitor with the flight (where it just came from) and where to go when you get into the baggage area.</u> <i>Signs led to baggage claim areas for different airlines. Monitors had carousel number with flight number.</i>
4	Walk to the taxi waiting area	Yes	<u>Was clearly labeled;</u> <i>Followed signs for ground transportation, outside doors at baggage claim</i>
5	Take a taxi		<i>Taxi stops were marked with overhead signs.</i>

Additional Comments:

Note: If you're on the rail and you ride it too far (e.g. from E to baggage claim), you have to go back through security to re-enter a concourse. Signs like "No entry beyond this point" would be helpful. I wasn't sure when "outside" of security until I saw signs on the way back in. They had this at Memphis.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Dulles (IAD)**Scenario: 3**

Step		Complete?	Comments
1	Exit arrival gate	Yes	<i>Plane landed on "remote landing strip;" people mover took us to main terminal, so we didn't see any of the concourse(s) on the way to baggage claim.</i>
2	Walk to luggage claim area	Yes	<u>There was no real direction as to which number our flights baggage claim was to be at, only had someone tell us because we were last flight in of the day. Would be confusing if there was a lot of people and flights coming in.</u> <i>Followed signs and crowd to baggage claim area. Representative. Was directing crowd to the correct carousel. (Appeared to be only incoming flight).</i>
3	Take luggage	Yes	<i>No monitors at carousel with flight info, but only one carousel were in use. Waited for Christine's bag to come around.</i>
4	Walk to the taxi waiting area	Yes	<u>Not real clear where the taxi area was.</u> <i>Walked towards "ground transportation" signs/exit doors. Taxi driver approached us and offered to drive us.</i>
5	Take a taxi	Yes	<i>Took taxi from Dulles airport to hotel (~30 miles)</i>

Additional Comments:

NOTE: Although we came in late and were not able to look around, while exiting there were a lot of signs that could possibly be confusing; had to many signs.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Reagan (DCA)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking	No	
2	Enter long term parking	No	
3	Park in long term parking	No	
4	Retrieve baggage from car	Yes	<i>Got from shuttle, dropped us off at our airline. Shuttle driver dropped us off near Delta check-in area. Followed signs for Delta check-in.</i>
5	Locate Main Terminal	Yes	<i>Building was visible from shuttle drop-off. No need to look for signs directing to main terminal.</i>
6	Enter Main terminal	Yes	<i>Inside entrance, followed signs for Delta check in.</i>
7	Retrieve name of airline	Yes	<u>Although Delta was easy to find on the outside of the airport (drop off area) once inside we had to search for the check in area. It was not clearly labeled and we had to look around to find it.</u> <i>"Delta" name was retrieved at time we boarded hotel shuttle to take us to airport, so that shuttle driver knew where to drop us off.</i>
8	Check in bags and print boarding pass	Yes	<i>Approached check-in area and representative. Directed to kiosks rather than ticket counter. No line at either rep. or kiosk. A</i>
9	Go through security	Yes	<u>A little jumbled (cramped space for a lot of passengers); after we checked in we mostly followed other people in order to get to the security gate, not very organized</u> <i>* Followed signs to Delta gates. Waited in line for security check.</i>
10	Find the concourse	Yes	<u>No definite separate concourses, just 3 wings to chose from, we followed signs to our gate number.</u> <i>* Once past security, followed signs for gate number.</i>
11	Find the departure gate	Yes	<u>The gate was a little difficult to locate. After looking back on it, they were ordered with even on the left and odd on the right.</u> <i>** Departure gates were in a U shape in our concourse, in combination with several food vendors, which made the area seem crowded. Signs were somewhat misleading-- Delta shuttle (airline or shuttle to Delta gates???) E17-22 on one side; E18 is actually on opposite side.</i>
12	Board	Yes	<i>Monitor was difficult to read from seats in gate. Had to approach monitor more than once to ensure gate hadn't changed.</i>

Additional Comments:

* There were two areas for security. We mostly followed people in order to get to the right security gate, but we were a little unsure until we found our gate number, which was right under where the security gate was. It was a very confusing airport.

** The reason it might be confusing for someone who has not been to this airport before is because the area the gates are in is a giant open square. One would assume with a large open space the numbers would go in order from left to right, but I think there is a standard that all airports have to number their gates with even on left and odd on the right.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Reagan (DCA)

Scenario: 2

Step		Complete?	Comments
1	Exit arrival gate	yes	
2	Check for gate information	yes	<u>There was a screen in the main congregation area of where all the gates were</u>
3	Go to rail station	no	<i>No rail station. Moving sidewalks within concourses.</i>
4	Take rail to concourse A	no	<i>Followed sign within concourse to travel to another gate. Gates were clearly labeled, but hallways were congested.</i>
5	Go to departure gate	yes	

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Detroit (DTW)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking	No	
2	Enter long term parking	No	
3	Park in long term parking lot	No	
4	Retrieve baggage from car	No	
5	Locate Main Terminal	Yes	<u>Where we were at there was only one main entrance, based upon the picture of the overall airport there are other main entrances depending on which airline one had.</u>
6	Enter Main terminal	Yes	<u>Well labeled as to where to go for Delta; Delta had a check in to help customers in the parking garage</u>
7	Retrieve name of airline	Yes	<u>Only airline was Delta at our entrance; Large Delta ticketing area, easy to find, little to no congestion</u>
8	Check in bags and print boarding pass		<i>Had kiosks at the back of ticketing area and at counters</i>
9	Go through security	Yes	<u>Right by check in, easy to get to; Followed signs for "All flights" to security checkpoint. Waited in relatively short line.</u>
10	Find the concourse	Yes	<u>Well labeled, had good screens to double check where our gate was at. Entered A concourse beyond security. Noticed signs for B, C concourses.</u>
11	Find the departure gate	Yes	<u>well labeled, easy to get to; Took moving sidewalk to gate within A. Signs at end of each moving sidewalk. Gate numbers w/digital sign for departure location were easy to read.</u>
12	Board	Yes	<i>Small seating areas caused line to spill into hallways during boarding.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Detroit (DTW)

Scenario: 2

Step		Complete?	Comments
1	Exit arrival gate	Yes	<i>Noticed wide hallways immediately when we exited gate. No monitor with departures inside gate like Atlanta. Concourses/gates otherwise similar to Atlanta.</i>
2	Check for gate information	Yes	<u>Was not right off of gate and had to guess which way to go to get to a screen, followed the crowd to screen, was only a few gates away.</u> <i>Monitors immediately outside of gate with flight info/gate number. Next flight in same terminal we arrived in (A).</i>
3	Go to rail station	Yes	<u>Rail system was inside the concourse A; It was above the main walkway. This may be a good idea, but what if situation would put the train over a rail and into a crowd.</u> <i>The rail was above ground and visible from main floor. Ran on open track. Directories for rail were present in middle of hallways with time to next stop, lights on its current position. Had to walk some distance (used moving sidewalks) to board rail and go up floor via escalator or elevator.</i>
4	Take rail to concourse A	Yes	<u>A little confusing at first to find the entrance. Was not 100% clear where to go.</u> <i>Boarded rail and went from one end of terminal A to other then back to middle of terminal A. Exited rail and followed signs to B and C to check them out. Very long tunnel to B and C ("tunnel of lights"). Moving sidewalks in both directions. Followed signs up escalators to B and C.</i>
5	Go to departure gate	Yes	<i>Went back through tunnel to board rail at terminal A. Took rail to nearest stop at our gate. Used moving sidewalks to get nearest our gate. Gates were small-- many people had to stand in hallway which blocked traffic in one direction. Monitor with flight info was large and could read from seat. Flight was ~1.5 hrs. delayed.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Detroit (DTW)

Scenario: 3

Step		Complete?	Comments (differences from script, key points re: usability features)
1	Exit arrival gate	Yes	
2	Walk to luggage claim area	Yes	<u>Easy to follow signs to area once we found a sign.</u> <i>Took moving sidewalks + rail to baggage claim area within terminal A. Signs abundant and easy to follow.</i>
3	Take luggage	Yes	<u>Had signs right at entrance as to which flight was at which claim area.</u> <i>Found our flight on monitor and identified carousel.</i>
4	Walk to the taxi waiting area	Yes	<u>Easy to follow signs to get to taxi area, had a kiosk to help get one.</u> <i>Ground transportation could be confusing because hotel shuttles/taxis/parking on different levels. Passenger pickup was easiest to find, immediately outside doors from baggage claim. Must go up a floor and across pathway to hotel shuttles/taxis. Took many pictures of this to help describe.</i>
5	Take a taxi	No	

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Memphis (MEM)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking		
2	Enter long term parking		
3	Park in long term parking lot		
4	Retrieve baggage from car		
5	Locate Main Terminal	Yes	<u>There is only one terminal for this airport.</u>
6	Enter Main terminal	Yes	<i>Went to main terminal from concourse B but not from parking. Signs let you know you were exiting secure area and no re-entry without boarding pass.</i>
7	Retrieve name of airline	Yes	<i>Several pictures of ticketing counters. No queues, only a few people being served at counters.</i>
8	Check in bags and print boarding pass		
9	Go through security	Yes	<u>There are 3 separate security gates to go through depending on your terminal. It made it a lot faster to have each one separated to help travelers to get to where they need to simpler.</u> <i>Main security checkpoint for all concourses. Concourses A and C have their own security checkpoint which weren't being utilized. Signs at main checkpoint should direct people to additional checkpoints so you don't wait in long line unnecessarily. Once in Concourse C, could go to any concourse without going back through security. (Same at all airports I think).</i>
10	Find the concourse	Yes	<u>Was well labeled and easy to get to.</u> <i>Moving sidewalks between concourses. No moving sidewalks within concourse, but not needed because they're not that long.</i>
11	Find the departure gate	Yes	<u>I think that GTR to Memphis had its own gate for all flights.</u> <i>Gates clearly labeled. Older monitors within gates with flight info= more difficult to read.</i>
12	Board	Yes	

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Memphis (MEM)

Scenario: 2

Step		Complete?	Comments (differences from script, key points re: usability features)
1	Exit arrival gate	Yes	
2	Check for gate information	Yes	
3	Go to rail station	No	<u>No rail system.</u> <i>No rail.</i>
4	Take rail to concourse A	No	<i>Used moving sidewalks to get to main terminal and other concourses.</i>
5	Go to departure gate	Yes	<i>Layout of concourses not as easy to grasp unless you've looked at map. Directories seemed few and far between when we were looking for restaurant. Restaurants not listed, only logos on map-- difficult to read unless you're right on it.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Memphis (MEM)**Scenario: 3**

Step		Complete?	Comments (differences from script, key points re: usability features)
1	Exit arrival gate	Yes	
2	Walk to luggage claim area	Yes	<i>Followed signs for baggage claim and ground transportation.</i>
3	Take luggage		
4	Walk to the taxi waiting area	Yes	<i>Taxi area was easy to find, less congested than Detroit.</i>
5	Take a taxi		

Additional comments:

NOTE: Atlanta was just an average airport. There was nothing special about it, but not much bad to say about it. The only thing that keeps it from being great was that although it was clearly labeled where to go, while walking around, they layout was not a usual layout. (See slide 49) The walk ways from the three concourses were not well designed, they seemed like an afterthought as to how travelers would get form one concourse to another.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Jackson (JAN) Scenario: 1

Step		Complete	Comments
1	Go to long term parking	Yes	<u>Labeled but print is a little small</u> ; Signs from I20 to airport exit. Road sign leading to roundabout showing which lane to be in.
2	Enter long term parking	Yes	Road sign for long term parking.
3	Park in long term parking	Yes	Parking prices listed on ticket machine. No sign at gate that said "Long Term Parking." Looked to be only parking lot
4	Retrieve baggage from car	Yes	
5	Locate Main Terminal	Yes	Headed towards a big parking lot towards building, no sign that said to check in. Parked in first available spot. Parking garage was visible from lot. No other buildings visible. No sign for Main Terminal. Only visible signs were rental car companies. Walked towards parking garage/main terminal.
6	Enter Main terminal	Yes	Only sign that said check-in was inside the building, none on the outside. Entered on baggage claim level where taxis, shuttles drop off. Noticed escalator immediately with signs to All gates, ticketing.
7	Retrieve name of airline	Yes	Looked at itinerary for airline name-- United. Couldn't find United ticketing area. Had to read monitors above ticket counters to find departing flight. Found flight on monitor at Continental Express. Larger print would've been better on monitors so that you could read them without being right at ticket counter.
8	Check in bags and print boarding pass	Yes	<u>The only bad thing about a security check-in generally takes a good few minutes to unload everything, and then load it back up.</u> Didn't check a bag. At Continental Express check-in, one line for 2 kiosks/1 rep. Used kiosk. Some people waiting for rep only.
9	Go through security	Yes	Only done by gate numbers, East and West Terminal; had to find gate number to get to <u>concourse.</u> Security checkpoint outside of each of 2 concourses. 1 line for 1 body scanner and 1 luggage scanner. Little congestion beyond scanners like most airports. Plenty of space to gather things, put shoes back on.
10	Find the concourse	Yes	<u>Well labeled, easy to get to.</u> Must go through security at your concourse. Can't go between concourses without going through security again.
11	Find the departure gate	Yes	Four gates in our concourse. Evens one side, odds other side. Plenty of seating inside gates.
12	Board	Yes	Monitor inside gate with flight info was large enough to read from seat.

Additional comments: NOTE: United and Continental Airlines merged and for those who do not know that, going to the airport was confusing because there was not sign for United. Had to ask around in order to find what airline to check in at.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Jackson (JAN) Scenario: 2

Step		Complete?	Comments
1	Exit arrival gate		<i>Exited at gate adjacent to gate we left from, so knew whether to go right or left outside of gate. No signs directly outside of gate for baggage claim.</i>
2	Walk to luggage claim area		<u>Easily labeled.</u> <i>Signs at concourse exit for baggage claim. Followed signs down escalator to baggage claim.</i>
3	Take luggage		<i>Found flight on monitor for our carousel. Only incoming flight so there was no confusion about which baggage carousel to go to. Carousels were numbered, not labeled by airline. No central area for monitors, only monitors on carousels, so you would have to walk around to find yours if other incoming flights.</i>
4	Walk to the taxi waiting area		<u>Easy to get to, outside of baggage claim.</u> <i>Taxi pickup directly outside from baggage claim.</i>
5	Take a taxi		

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston – Bush (IAH)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking		
2	Enter long term parking		
3	Park in long term parking lot		
4	Retrieve baggage from car		
5	Locate Main Terminal	Yes	<u>Could not get into main terminal; They were separated into 3 different terminals based upon airline. The one that we transferred into (A) was separated from the others, only connected by a separate train and terminal.</u>
6	Enter Main terminal	Yes	<i>Entered through Continental entrance (Concourse A). Ticketing is separated into different terminals by Airline. In Terminal B (where we arrived) ticketing for Continental Only. Didn't look at ticketing in other terminals.</i>
7	Retrieve name of airline	Yes	<u>United/Continental Merged and they had their own terminal/concourse.</u> <i>Easy to find ticketing for your airline as long as you arrive in correct terminal. No lines at any of the counters.</i>
8	Check in bags and print boarding pass		
9	Go through security	Yes	<u>Seemed to be a little chaotic when going through (*refer to transfer notes).</u> <i>Security checkpoint was visible from ticketing area. Not sure whether you can go through security at one terminal and then enter another without going through security again.</i>
10	Find the concourse	Yes	<u>We were in the concourse before we went through security / it was separated that way.</u> <i>Monitors within ticketing had only airline flights. Checked boarding pass for gate.</i>
11	Find the departure gate	Yes	<i>Inside secure area of terminal, gates were split to two concourses. No moving sidewalks.</i>
12	Board	Yes	

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston – Bush (IAH)

Scenario: 2

Step		Complete?	Comments
1	Exit arrival gate	Yes	
2	Check for gate information	Yes	<u>Info was in a general are of exit gate easy to find and get to.</u> <i>Monitors a few feet outside of gate with flight information.</i>
3	Go to rail station	Yes	<i>Needed to get from concourse B to A. Following signs to ACDE led outside of security. Followed signs down to rail station.</i>
4	Take rail to concourse A	Yes	<i>Rail monitors told next stop only; no current location or time to arrival. Train itself was older and slower. Rode train from B to A.</i>
5	Go to departure gate	Yes	<u>Had to leave security to get to new terminal from B to A -> seems like it would b inconvenient for transfer flights.</u> <i>Exited train and had to go back up to main floor with ticketing and go back through security.</i>

Additional Comments:

NOTE: Absolutely did not like terminal/concourse A was separated from the other terminals and concourses (see picture)
Being a transfer it would not make sense to have to go though security again. If someone had a short layover, they might not be able to make it though and to concourse A. All others are connected, it does not make sense that A is the only Concourse that is separate from all the others and has a separate security.

Unsure whether you have to go through security again to transfer to different terminal/concourse.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston – Bush (IAH)

Scenario: 3

Step		Complete?	Comments
1	Exit arrival gate	Yes	
2	Walk to luggage claim area	Yes	<u>Each concourse has its own baggage claim, but still had screens to tell which belt was for which flight.</u> <i>Noticed sign for no reentry beyond this point when following signs for baggage claim.</i>
3	Take luggage	Yes	<i>Baggage claim within terminal we arrived in, not in Main Terminal like most airports. Short walk and downstairs from gate; didn't have to take rail. Since this claim area was only for United flights, only 4-5 carousels. Monitors had carousel # + flight info.</i>
4	Walk to the taxi waiting area	Yes	<u>Well labeled, had a stand by taxi area with a person to help a customer and make sure they get to where they need to.</u> <i>Signs for ground transportation at exit doors. Signs for taxis were visible.</i>
5	Take a taxi	Yes	

Additional Comments:

Didn't feel like such a huge airport because everything was divided by airline - ticketing / security / gates / baggage claim all in every terminal

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston-Hobby (HOU)

Scenario: 1

Step		Complete?	Comments
1	Go to long term parking		
2	Enter long term parking		
3	Park in long term parking lot		
4	Retrieve baggage from car		
5	Locate Main Terminal	Yes	<u>Only 1 terminal</u>
6	Enter Main terminal	Yes	
7	Retrieve name of airline	Yes	<u>Southwest had its own check in area, because of renovations; had to walk through terminal a little to get to area of check in. Southwest ticket counters were separate from other airlines. Signs for "ticketing" and "Southwest ticketing."</u>
8	Check in bags and print boarding pass		
9	Go through security	Yes	<u>Had a mirror above the security gate (don't know what it is for). One security checkpoint. Sign reads "All passengers enter here."</u>
10	Find the concourse	Yes	<u>Only 1 concourse; Only one concourse, 2 sets of gates.</u>
11	Find the departure gate	Yes	<u>Easy to get to; Found gate based on sign w/ number. Verified flight on monitor at gate. Noticed departing time was different but monitor didn't specify that it was delayed. Gate change close to departing time to right across the hall.</u>
12	Board	Yes	<i>Monitors with gate number, departure location, flight info all easy to read from a distance.</i>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston-Hobby (HOU)

Scenario: 2

	Step	Complete?	Comments
1	Exit arrival gate	Yes	<i>Had to decide right or left when exiting gate (no sign). Followed crowd.</i>
2	Check for gate information	Yes	<u>In main area of congregation (see picture),</u> <i>Monitors in central area of concourse. Found flight easily.</i>
3	Go to rail station		<u>No rail station;</u> <i>No rail station-- only one concourse.</i>
4	Take rail to concourse A		<i>Walked length of concourse. No moving sidewalks.</i>
5	Go to departure gate	Yes	<u>Easy to get to (had to go to main area to get to gate right next to it)</u>

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.

Airport: Houston-Hobby (HOU)

Scenario: 3

Step		Complete?	Comments
1	Exit arrival gate	Yes	<i>Followed people to get to first sign to find baggage claim; <u>No sign for baggage claim immediately at gate exit.</u></i>
2	Walk to luggage claim area	Yes	<i><u>Once we found a sign, it was easy to get to, even with the airport under construction;</u> All airlines' baggage claim in one area. Found flight on monitor with carousel number.</i>
3	Take luggage		<i>Few people in area, but small space.</i>
4	Walk to the taxi waiting area	Yes	<i><u>Easy to get to, once outside, found easily, had a kiosk to talk to someone about getting a cab.</u> Followed signs for ground transportation. More signage on walls/ columns vs. overhead. Taxis in same area as passenger pickup, immediately outside doors from baggage claim.</i>
5	Take a taxi		

Additional Comments:

Airport was under renovation, but no inconvenience. Areas not under construction seemed updated.

** Underlined text denotes experienced flyer comments. Italicized text denotes novice flyer comments.