Mini Project
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Task

Evaluate the current interface and design a new interface that supports the various users and improves performance for infrequent passengers who will begin their ride at the Washington National Airport.

Problem Hypothesis

Just plain confusion is what many new or infrequent traveler's utilizing the metro system in Washington D.C. encounter on a daily basis. So much so that there are YouTube videos with metro hacks and tips readily available made by people that have had the same user experiences. Frequent users and business traveler's access smart phone apps such as metro hero (metro map) and city mapper (station transfer help) that a new or infrequent user may not know or use. Users face cognitive overload that interferes with task time and efficiency to conduct and complete independent travel with the current metro fare system.

Problem Analysis

Gulf of Evaluation

Everyone must buy a Smartrip card to ride the metro. The current system places three different vending machines in front of the user. First a user must figure out which one produces a fare ticket. These are the orange/blue colored machines. The black "add fare "machines are used to add on additional fare money to an already purchased ticket. The brown "exit fare" machines is for users that lack the amount of money to get out of the train station and need to add fare to the ticket so that they can exit. Once they determine which machine to purchase fares they can then start the process of purchasing a Smartrip ticket. When they arrive at the correct fare ticket machine the next gulf of evaluation is the control panel and deciphering it's lay out. (Whitenton, 2018)

Gulf of Execution

Norman's gulf of execution in the current system leads to cognitive overload with numerous slips and/or mistakes for the user. (Norman, 1988) Maps are readily available in the terminals and provide visual information to the user on a large space for easy reading. However, they can be hard for new people to understand, especially if they have never been on a metro system before. The map isn't to scale which some users may mistake and think their destination is a few blocks walk from the metro stop when in reality it is a few miles. The first challenging task is trying to figure out the metro map with the destination list. Locating a specific destination and deciphering which line to ride and where to transfer or get off can cause considerable confusion and stress leading to cognitive overload. An additional burden is the language barrier which is common in metro D.C. Many train lines stop at the same transfer stations confusing users where or if they should transfer to another train line if they read the map incorrectly. Deciding which line to ride and where to get off can cause anxiety before a user even purchases a fare ticket because there is no feedback that tells them if they are correct other than the distribution list.

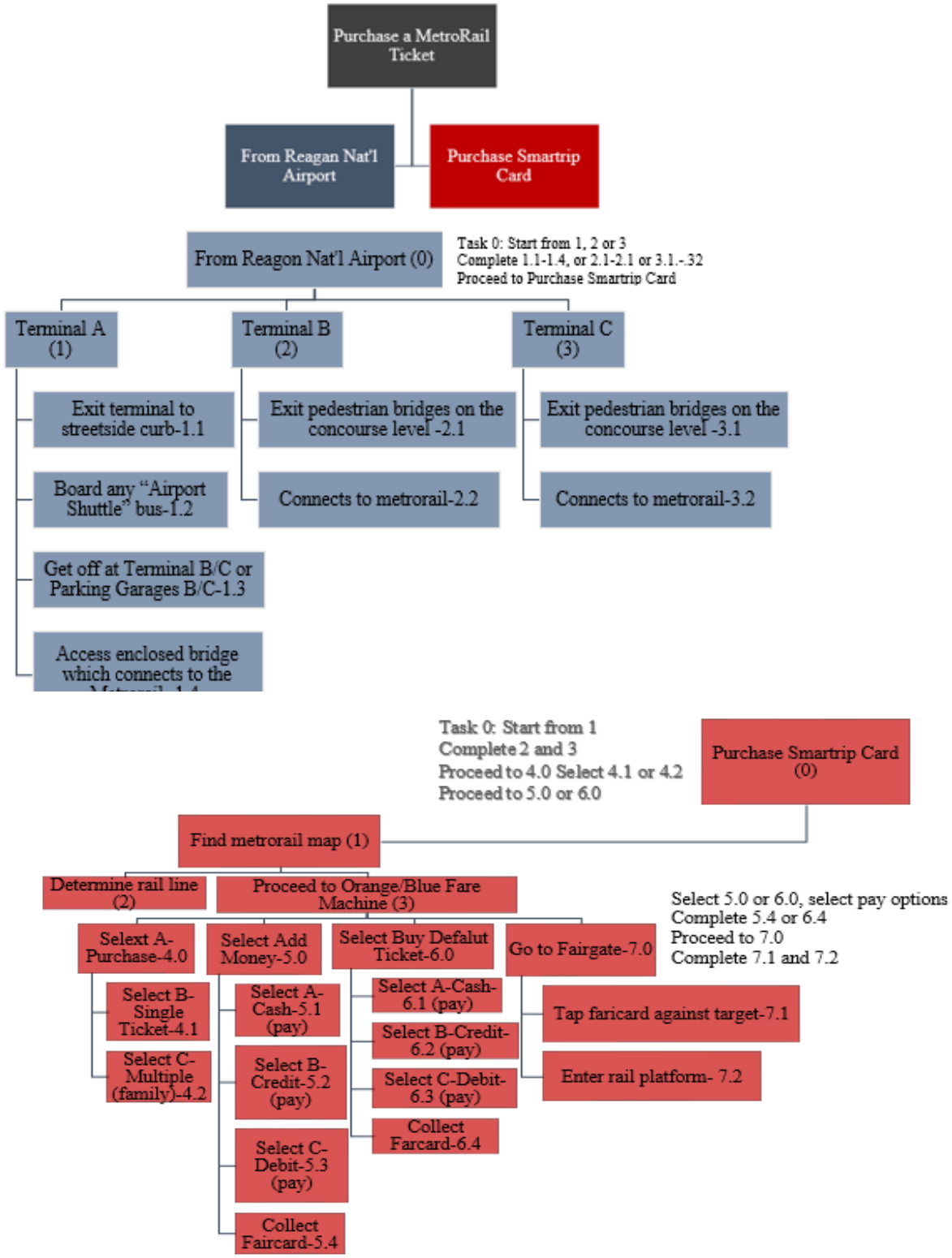
The user must then decide what kind of ticket they need. Although the user follows the prompts in getting a ticket some of the tasks cause mistakes and inefficiencies. The choices are either a single ticket for one person or a multiple ticket (for family). This is confusing because some users might think that single and multiple mean number of stops (one trip or round trip) instead of people. If they choose multiple they need to know that for each paying adult, two children under five can ride free. This is not readily available information so many people end up buying additional tickets and spending more money than they need to. There are also reduced rates for students and seniors as well as increased rates during rush hour to be considered.

After a user chooses the type of ticket needed they then decide how much they should pay. If they buy the default pass for $8.00 it will probably be the best buy for their money if they plan on using the metro for more than one stop. If they pay as they go, they need to keep in mind that during rush hour, fares cost more and they need to figure that into the total amount. If they don't, then they will probably be adding fare when they exit. They can use the same fare ticket to add more money but that takes more time. Once they know which ticket to buy and the amount needed they can pay by cash, credit or debit. If they pay with cash, they will only receive change if they overpay. Once they receive the fare ticket they can proceed to the fare gate.

Gestalt Principles

Although the Smartrip fare machine follows Gestalt's' law of similarity with color, shape and size the brain uses energy to create a link between the circles (points) vs. rectangles (lines) to try to understand the relationships. (Interactive Foundation, 2018) In this case, the orange circles indicate steps to purchase a ticket, whereas the blue rectangles are instructions and pay options. The orange circles provide multi-stability that isolates the orange circles from the rest of the design, drawing the eye to it as an object. Uniform connectedness was ignored by placing the orange circles so far apart. Placing them closer together would allow the brain to spend less time understanding and processing the relationship. The purchase steps in large white letters by the orange circles are found in different locations (one on the left side of the circle and two on the right) and disrupt continuation as well. Proximity in relation to tasks such as payment and the control panel could be improved. The past experience principle relates to what users know and is often a cultural experience. Most people have experienced an ATM machine and would find that a similar process in purchasing a ticket. The following table demonstrates the tasks of buying a fare ticket from the airport. (See Table 1)

Table 1:
Hierarchical Task Analysis



Design and Development

The goal of the new interface design is to reduce cognitive load and increase efficiency in purchasing a ticket for independent metro travel. The design is developed using design thinking methodology through design based research. (See Figure 1) It is focused on users (user centered) and tasks according to needs of new and infrequent users. The design follows an iterative process. I choose this model because it focuses on solutions for real users, explores innovative ideas, and creates prototypes that are tested by the users themselves. (Design Based Research Collective, 2003, Buchanan, 1992).

> Design thinking is extremely useful in tackling complex problems that are ill-defined or unknown, by understanding the human needs involved, by reframing the problem in human-centric ways, by creating many ideas in brainstorming sessions, and by adopting a hands-on approach in prototyping and testing. (Interactive Foundation, 2018)

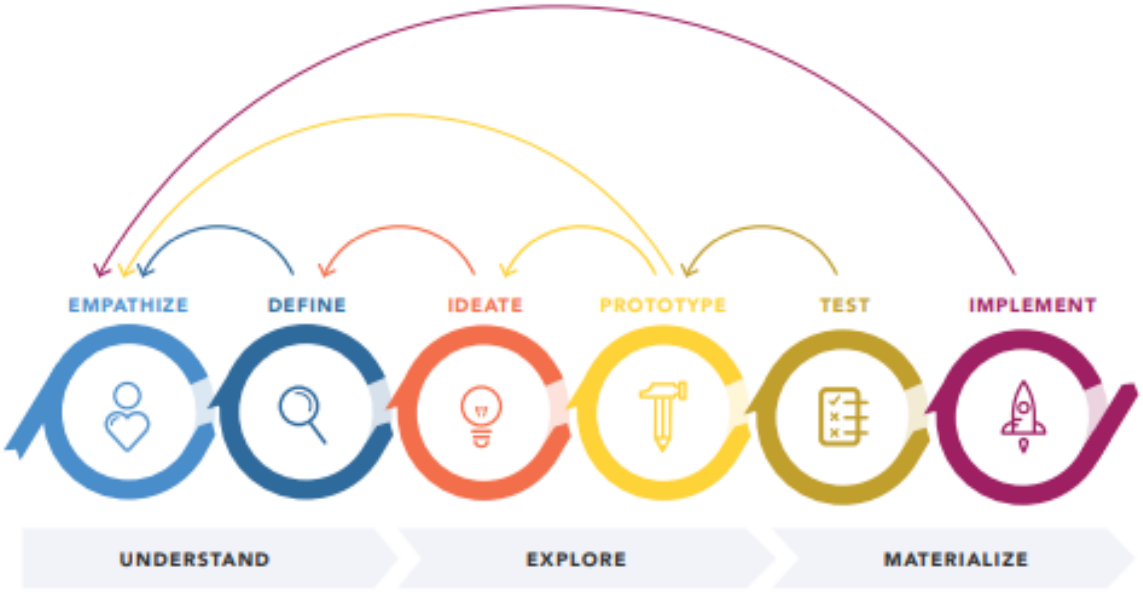


Figure 1. Design Thinking Method. Source: NNGroup.com, Design Thinking 101

Using this process, the design steps are outlined below:

Empathize- I have had my own set of experiences with metro systems (including D.C.) in the United States as well as in foreign countries. I feel as a user myself I can readily understand the frustration and anxiety accompanied with trying to figure out a system in a crowded and bustling place. Not knowing the local language and currency puts an additional cognitive strain on users. Also, not knowing the city and determining which train line and stop can cause extreme frustration. In Barcelona, I got caught in a train terminal and couldn't leave because I bought the wrong train line ticket. The exit fare machine didn't work and ate my fare card so I had to wait for security to let me out. They told me that happens all the time. Maybe the machine should be fixed?

Define- Through user research and observations a list of behaviors and slips can be put together to create a list of current unmet user needs. What are the pain points that need to be addressed? (See Table 2)

Table 2:
Slips and Mistakes (on next page)

Category	Behavior	Source of Confusion	Slips/Mistakes	Unmet Needs
Metro Map	Cognitive\ visual literacy Figuring out which train line, stop and transfers to take	Choosing the correct train line and stop in an unfamiliar city Map destination list is to dense to make an accurate decision in a timely manner	-Choosing wrong train line -Reading map to scale -Getting off at the wrong stop -Transferring when not necessary -Not transferring when necessary	Efficient way to find metro stop Visual Literacy
Ticket Purchase	Choosing a machine	Three machines to review and choose	Selecting wrong machine and spending cognitive energy	Clearly marked machine
Ticket Choice	Reading purchasing directions on kiosk	Directions are in different places. Causes extra processing time to connect information Discounts and rush hour not included in rates	-Mistake single/multiple ticket definition -Select wrong ticket type -Buying to many multiple tickets or not enough -Not adding money for rush hour and underpaying -Overpaying (discounts not known)	Limited language Clear Steps / Process Fares automatically generated with all fees and discounts
Paying	Cash, Credit, Debit	Calculating correct ticket price for destination based on time of day	Over pay or underpay if discounts and rush hour rates are not known	Receiving change in cash and coins

Based on these findings user design needs I defined are:

- The fare ticket machine should be visibly easy to pick out. Users should not have to guess which machine is used to purchase a fare ticket. Machines can be combined into one.
- The process to buy a ticket should be clearer and easier and follow a mental model. The directions and steps are currently labeled all over the front of the machine making it hard to follow.
- There are too many rules about discounts and rush hours and added fare costs. This should be built into the system and prompt the user while purchasing the ticket.
- If paying with cash, currency received back should include dollars and coins.
- Languages other than English should be available. D.C. is an international city. I had to use Google Translate in Spain last summer to read the Metro fare ticket machine which was only in Catalonian. That was an unmet need for a native English speaker.

Ideate- At this point of the process brainstorming ideas will help to redefine the design. No idea is bad. This would ideally be a team activity. The brainstorming ideas I came up with are to create a touch screen fare machine based on google maps with an ATM type function. This fits most people's mental models because they use these interfaces and are familiar with them. This system might be expensive for a city to implement but the user experience would be easier and more efficient and over time pay for itself with only one machine vs. three. It could also be made into a smart phone app for frequent users to pre-pay.

Prototype- This project will show three low fidelity mockups to demonstrate design components and to get feedback from actual users. (See prototypes in next section)

Test-Testing will occur at various points to make sure user needs are being met. This phase will also include evaluation protocols to find out if the design improves how users think and feel about the tasks. (See evaluation section)

Implement- This step involves developing the prototype into a product and putting it in the marketplace after all the other steps have been completed satisfactorily. (Gibbons, 2016)

Design Recommendations

The new design to reduce cognitive load and increase efficiency for Smartrip fare machines is based on the DBR model keeping in mind Gestalt's principles:

- The fare machine will be a touch screen with a keyboard and voice command in the shape of an ATM style kiosk with payment / receipt console.
- There will be a language option menu for users to choose. Directions will be in text and voice in users selected language as well as graphics for visual cues.
- A google map screen will appear and ask the user to key in a place or address with a pop up menu of destination choices (voice command option) or touch an area of the map.
- Once the user types, uses voice command or touches the area of destination a location balloon will appear on the map marking the metro station stop and indicating the train line and transfers if any.
- The user will follow the prompt on screen and choose each selection to determine fare price. Users can pay with cash, debit or credit and receive dollars and coins for change.
- When the user pays the fare an optional receipt can be printed with the "directions" like google maps giving the train line, transfer and stop for reference in the language the user chooses.
- To add extra fare or exit fare the user would insert the fare card and follow prompts.

Design Prototypes

Image 1: New Kiosk Desgn Mockup

Image 2: Touch Screen Mock Up of Finding Train Line and Metro Stop

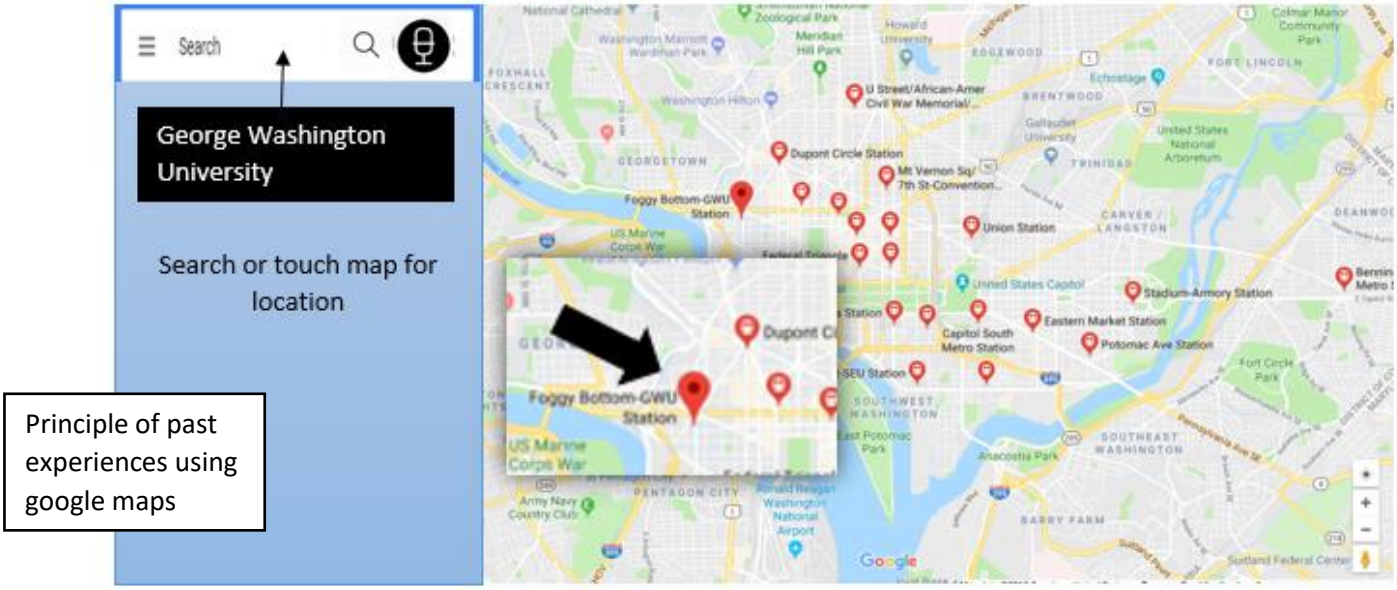
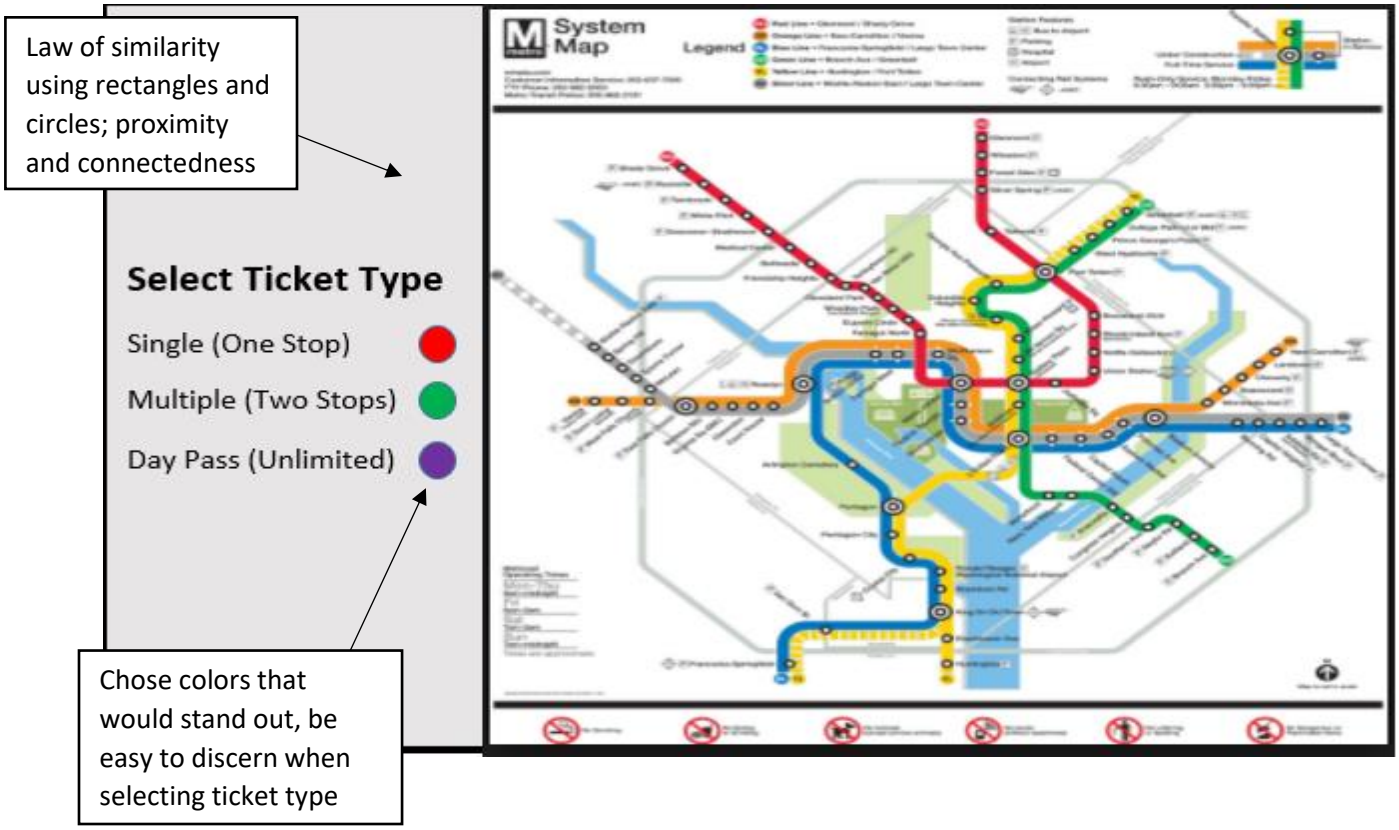


Image 3: Touch Screen Mock Up of Selecting Fare Ticket



Evaluation Methods

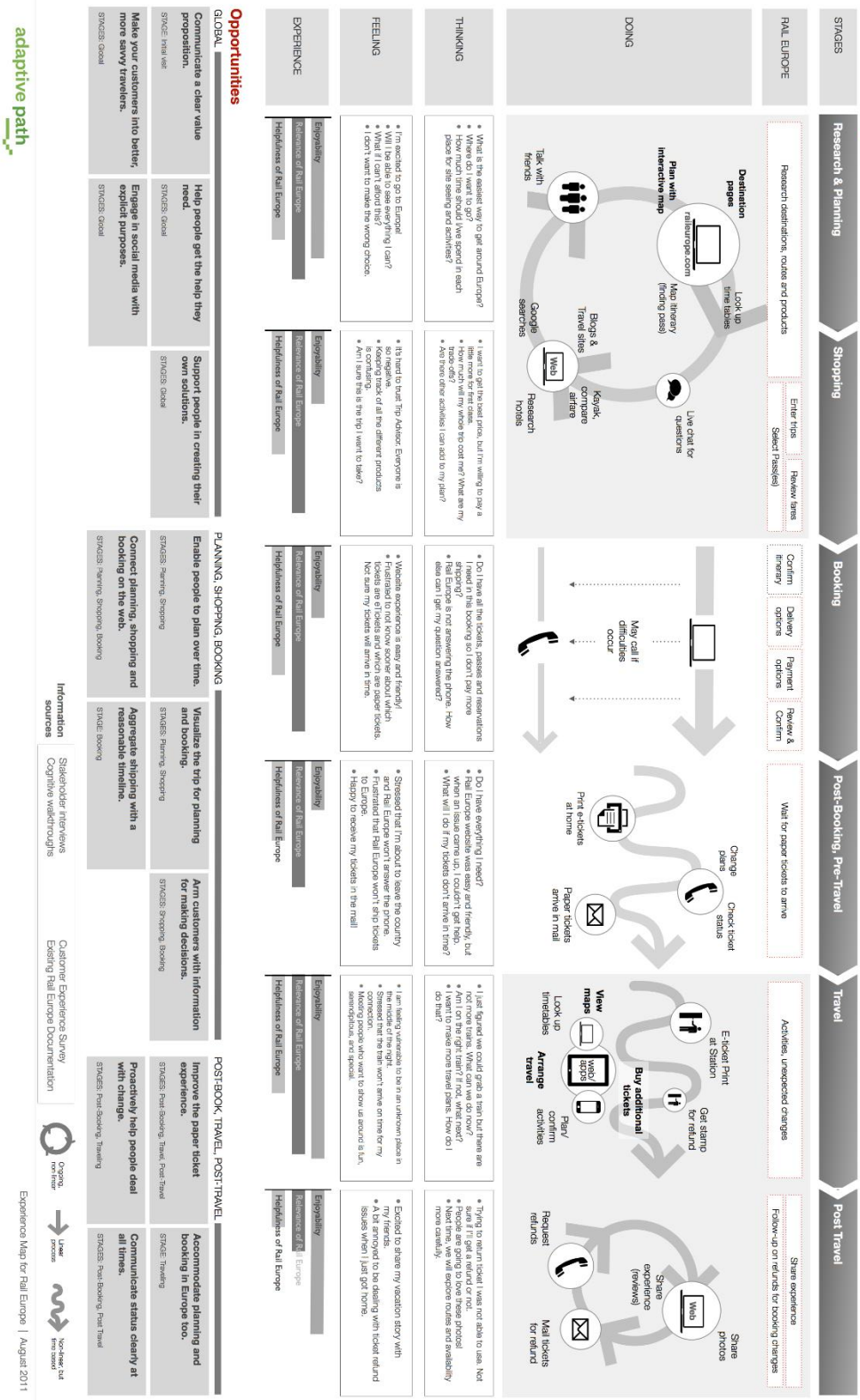
After the initial prototype is designed the first iteration in evaluating the new design will be conducting a customer experience map. (See Appendix 1) This formative evaluation method compares the current functions of the new system to the current user experience across several touchpoints. This artifact should be from the point of view of the user, not the designer and provide information about unmet needs, issues, frustrations, and any failures required to deliver the expected user experience. It serves as an actionable mechanism and not a conclusion for a user centered design framework. Customer experience maps will help the system designers to understand how a user performs a task (how they purchase a metro ticket); how well the design meets the needs of the users; and produces a roadmap to implementation. (Halvorsrud, Kvale, & Følstad, 2016)

Being able to understand different user viewpoints is crucial. Everyone has their own mental model they draw from when performing a task. Setting up user profiles will help identify types of users needed. In testing this system, it is significantly important to choose new or infrequent metro users and those with different native language backgrounds to see differences in user experiences. This will help determine quickly what the “missing” parts or what functions aren’t working well. ADA compliance and ergonomics should be considered in the overall design. My design includes some elements but not all at this time. The number pad incudes brail and the touch screen uses voice command for those with sight impairments but doesn’t solve all issues. The hearing impaired should be able to perform the task by using the keyboard and prompts (with visuals). To accommodate those in wheelchairs there should be some kiosks available at each station with recommended height requirements and adjustments for a wheel chair to fit comfortably while the user is performing the task.

Usability testing is often the best way to create a customer experience map. Choosing a method that reflects user expectations and experiences is essential to this mapping process. Methods used for this new design include system task performances, SUS survey and follow up semi-structured interviews with user groups.

After conducting the usability tests the next step is creating a user layer that documents the task flow. Using a sticky note desktop program, I can keep track of what works well and what needs to be improved after each user test and add and rearrange the “notes” during the process. After this process I can create a design layer that maps the ideal user experience for the system. Joining these two layers together will help identify areas that are good, missing or in direct conflict with the user experience to start assembling the map. This artifact is a living document that can be used to redesign parts of the system and will be updated during each iteration. I chose formative evaluation instead of summative for this design project because if a city is going to spend a substantial amount of money on a product they will want it to function and be efficient before putting it out for public use rather than after the fact and have a substandard product.

Appendix 1: Customer Experience Map Example



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https://www.wmata.com/fares/vending.cfm

https://www.wmata.com/rider-guide/new-riders/

https://www.tripsavvy.com/dc-metro-guide-1040448

http://www.flyreagan.com/dca/metrorail-station.