



Starting Points

fig 6 – evening view of the street scene at the Ballston Metro entrance

Seeds for this thesis were first sown during a graduate survey course in human factors engineering. For an assignment I chose to conduct a human factors analysis of the WMATA automatic farecard machines, which along with the entrance gates comprise the Automated Fare Collection System (AFCS). This topic appealed to me because, as an advocate of strong public resources, I have a desire to see public transportation become accessible, intelligent, and well designed. For the analysis I spent research time, both daytime and evening, at various Metrorail stations collecting quantitative and qualitative data. I took measurements of the farecard machines, timed transactions, photographed users, and interviewed both riders and WMATA employees.

The discipline of human factors engineering, also sometimes termed “ergonomics,” chiefly studies the relationships people have with “things,” meaning objects, tasks, spaces, environments, and information in visual and physical formats. The implicit understanding is that people are limited in their physical and mental abilities, some more than others. The human factors engineering community believes designers, engineers, and manufacturers should respect these limitations in creating things for people. **By compiling information and numerical data about the capabilities and needs of people, human factors engineers strive to enhance the effectiveness and efficiency by which work and other activities are carried out (M. Sanders and McCormick 1993).**

Though this quantitative approach has had credible success, human factors’ overall objective, to “improve people’s lives by way of enhancing certain aspects of living which humans value” (Meister 1995), cannot be fully realized via an engineering approach. What we as humans value, and the thought processes and emotional responses that lead us to those conclusions, are as individual and numerous as people themselves. **Human factors, with its reliance on physical and biomechanical data and analysis, has difficulty dealing with the aspects that most humanize us: namely the social, psychological, and emotional dimensions (Green and Jordan 1999).**

Gathering the findings from my investigations, it was evident that a lack of cohesion within the entrance system as a whole, was at the root of the issues surrounding the AFCS. Though repairing the engineering shortcomings of the automatic farecard machine would improve that individual piece of machinery, improving the system that contains that piece of machinery would benefit the user’s overall experience with it. Such an appropriate solution could only arise from holistic design thinking. **By widening the research focus to include a broad base of observational, experiential, and user-centered material, the industrial design process would receive diverse enough information to deliver an improved system product.** After fulfilling the engineering course’s requirements, I decided to pursue these broader design ideas concerning Metrorail’s entrance system as a thesis topic.



fig 7 – the entrance of the East Falls Church Station at night

Inspirations



fig 8 – escalator entrance tunnel at the Rosslyn Station

My personal relationship with the WMATA Metrorail system began while I was growing up in Arlington, VA, a suburb of Washington, D.C. Metrorail and I were born in the same year, 1976. As a child I rode with my father or friends, then later as an automobile-deficient adolescent, I used the Metrobus and Metrorail systems as primary sources of transportation, commuting to work, to play, and special events in and around the DC metro area. Years later these experiences became fuel for my creative writing. A collection of short stories I wrote in high school followed passengers on the 6 different rail lines, and poems attempted to capture moments more succinctly. This piece reflects on my childhood Metro experiences:

Perhaps it was the noises that echoed in subsonic vibrations
against towering concrete coffers of space,
simply otherworldly to a 6-year-old.

Captivated by this world of speeding trains,
I imagined the fantastic network of underground burrows,
winding tunnels as dark as outer space.

3 launching worlds closer to my hero Buck Rogers,
2 fellow passengers holding their posts as my dutiful crew,
1... we accelerate toward our next intergalactic adventure!

Moving at amusement-park speeds over bumpy paths,
unanchored riders tumbling,
my squeals of glee threatened to match the brakes' noises in pitch.

When the action halted, changing trains was yet another chance to practice
jumping into my own high-speed,
floating transport ship.

I am surely not the first person to find inspiration in Metrorail; the experience of riding the system brims with opportunities to observe and interact with a rich spread of people. Time spent in transit can be used to muse thoughtfully on the cultural mixing bowl that is a public transportation system. Upon entering a station, sometimes after descending 200 plus feet of escalator that seems to slice into the earth, riders find themselves in a cavernous place of monumental scale. Architect Harry Weese's arched dome ceilings, constructed entirely of rectangular concrete coffers, soar above, while the sound of riders' footsteps echo off the terra-cotta floor tiles in a percussive cloud. The Metrorail is an elegant creature among the world's transit systems, worthy of a considerably designed entrance system that brings its riders sensitively into the system's expanses.

To enrich the context of design work it is imperative that a project's designers have a good understanding of the topic at hand. For this project it was important to be informed about the WMATA Metrorail's history and ridership population. Research found that on average more than 725,000 people ride the Metrorail system each day, about a fifth of the WMATA's service area population of more than 3,500,000 people, the majority of which use Metro solely to commute to and from work (WMATA). Though a sizable ridership, the number implies that almost everyone in the service area population still regularly uses automobile transportation of some kind.

Created by the National Capital Transportation Act, a legislative compact between Virginia, Maryland, the District of Columbia, and the Federal government, the initial planning program proposed an 83-mile rapid rail system with 65 stations (Dieter 1990). It has since grown into the current system of 83 stations along 103 miles of rail line (WMATA). In 1973 when the Metro system was still in its development phase, the WMATA planning committee made the decision to install a magnetic stripe-based automated fare collection system. Though Metrorail opened on March 27, 1976, an additional year and two months passed before the Automatic Fare Collection System (will be referred to as the AFCS from here onwards) was installed. Prior to that improvement, all trips were the same flat rate and exact change fare boxes were used to collect fares (Dieter 1990).

The magnetic stripe farecard (fig 11) machines used by the WMATA in its Metrorail stations are manufactured by Cubic Transportation Systems Inc. and purchased as fully designed and manufactured components. This type of system was chosen over an exact fare structure or a standard rate token system because the WMATA had found during planning that the public preferred a system which charged by ride length (Dieter 1990). The magnetic stripe system made it possible to record the entry and exit points of a passenger's trip, from which an appropriate fare could be calculated (Tolliver 1995). The downside to using a magnetic stripe system is that it is often mechanically demanding, frequently needing costly repairs.

Over the years the AFCS machine's interface has remained largely unchanged. Currently used second and third generation machines are modeled on the first-generation farecard machine, which is no longer in use. Second generation (fig 9) machines replicated the first generation functionally, but they attempted to increase accessibility in order to meet ADA requirements. Metrorail's third generation AFCS machines are called "Passes/Farecards" machines because they allow users to purchase multiple magnetic stripe farecards at the same time, and also handle SmarTrip pass media transactions. Added features include the SmarTrip target and debit and credit card purchase options. Metrorail also uses "Exitfare" machines (fig 10) to add value to farecards that don't have enough credit on them to complete the rider's trip. The machine is a band-aid solution that compensates for problems in the AFCS system's design.



clockwise from top left:
fig 9 – row of AFCS farecard machines
fig 10 – an "Exitfare" machine
fig 11 – a magnetic stripe farecard



WMATA Background

Product Appeal



fig 12 – Kroger supermarket's beauty products aisle

Today's consumers are exposed to a vast spectrum of products, ever increasing in range and scope, which are presented to them en masse using the widest array of media ever employed (Palmer 2000). To cope, it seems consumers have learned to view, assess, and purchase items they feel are compatible with their personalities and ideals using complex reasoning and discrimination skills. **Purchasing power has become a tool with which to assert personal freedoms, display opinions, and influence economic and/or political change.** Similarly, ownership of an object can function comfortably as reassurance of an individual's rights within modern society (Garner 1998).

All of this puts an enormous amount of focus on products for sale in a commodity sense, while things whose "product" nature is less obvious fall off the consumer's radar. **Because it is more of an experience than a physical commodity, use of a mass transit system is not thought of as a purchasable "product."** Nor does mass transit fit into the "mobility product" paradigm where a tangible object, such as an automobile or motorcycle, is a personal possession and reflects a lifestyle choice. For many people choosing whether to use mass transit or an automobile, the decision is an economical solution to a transportation dilemma, shaped more by economics than by consumer desire or demand (Transportation Research Board 1999). Inflexible variables like service availability, routes, and schedules leave customers with a rigidly unattractive choice that meets their practical needs, but will never exceed them.

Too often the economically disadvantaged are forced to accept poor design deficient in quality, appearance, and accessibility as a living standard. Persons without the economic means to purchase a vehicle for personal transportation have only one choice: to accept public transportation whatever the state or condition of the system. Because they are tax dollar or government funded, public transportation systems often lack the financial resources that would enable hiring qualified designers. I believe that design is capable of affecting positive, progressive change within a society. **If designers are to be thought of as those who envision such innovation, then they must contribute their skills, talents, and time toward work on less monetarily attractive projects that could benefit the lives of ordinary people.** Public transportation is one such worthy venture not inherently "cool" in nature, which should not be allowed to fall by the wayside.

This thesis seeks to clarify design opportunities for the WMATA Metrorail and its ridership by applying user research techniques from the design field to better understand the relationship between product and user. By focusing on the point of purchase, the entrance area of a Metrorail station, the design research becomes a study of the purchasing act of a specific product, a farecard. The "retail setting" in which that transaction takes place consists of the interior environment, traffic patterns, lighting conditions, temperature, etc., and the information systems and physical equipment located within it. Treating the entrance system in this way casts the experience of entering the Metrorail system as a sellable item, which in turn becomes something to purchase in the eyes of the consumer.