E-Stations:
Enhanced Physical and Virtual Mobility for the Inner City

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1: WHAT IS AN E-STATION?

Residents of many inner city neighborhoods in the U.S. face two kinds of needs regarding access to goods and services.[1] The first need is for improved public transportation. In poor inner cities, residents who rely on buses must wait by the side of the road, unprotected from cold or inclement weather, possibly in unsafe locations, with little certainty of when the bus will arrive. The second kind of need is access to the internet, without it residents are deprived of the many advantages it offers, from e-mail to job information to purchasing goods through e-commerce. As a series of enclosed, computer-equipped and staffed bus stations, e-stations address both of these needs for access.

research and design for the first e-station

The e-station is a new type of building for which research, planning and design is centered around faculty and students of Architecture, Infrastructure Planning, and Management at the New Jersey Institute of Technology with support from the faculty and staff of the Departments of Information Technology, Biology, and Transportation Engineering. The effort is funded by the New Jersey State Department of Transportation, a National Transportation Center and the Casino Reinvestment Development Authority. The e-station concept is being developed in partnership with New Jersey Transit, both the Business Development and Transportation Engineering Departments of Newark, NJ, consulting engineers, a construction management firm, and several community-based organizations.

The process is a multidisciplinary one. After initial planning, an infrastructure planning studio focused on the e-station, assessing newly available transportation, telecommunication and computer technologies to determine their appropriate interface. The studio also researched related precedents and the social services that an e-station would offer. The goal of the studio was to define the technological and social infrastructure of e-stations. Faculty and students met with experts, collected a broad range of information and developed an understanding of the related technologies. With this information and the formulation of a theoretical framework for the e-station, the students created a detailed web-based document that defined a concept and program for further design and development. Led by faculty from the School of Management, the studio convened a focus group to obtain input from city residents. The main topics of discussion were transportation, social services and shopping, with particular emphasis paid to security and education.

The work of the infrastructure planning studio supported two comprehensive architectural design studios, whose work was reviewed by a panel of architects, engineers, community developers and researchers. Afterwards, a student-designed prototype was cost-analyzed by the construction management partner of the project. In addition, a team of students in the Small Business Institute in the School of Management used the infrastructure planning framework and prototypes to develop a business plan for the operation and management of the e-station that identifies opportunities for private entrepreneurs to work in partnership with community organizations.

description

The first and most important function of e-stations is to enhance the quality of public transportation. This means providing enclosed, secure bus shelters to increase the safety and comfort of those waiting for the bus and connecting the shelters to an intelligent

transportation system. Within this system, buses on major avenues will be fitted with devices that show the location of the bus. Computers and kiosks in each e-station access this information and allow the bus's estimated time of arrival to be displayed.

The second key purpose of e-stations is to provide a portal to the internet. In this way, poor urban residents who do not have computers at home or who cannot afford internet access will be able to benefit from the opportunities offered by connections to information, services and resources. In this way, e-stations will help bridge the digital divide. As an internet portal, the e-station will offer a variety of community and social services. At the very least, users can receive and send e-mail messages. Internet access will enable residents to make job searches and offer the opportunity to complete job applications online. As e-stations evolve, additional services connected to the internet can be developed. One is the opportunity for residents to purchase goods on-line and to have the purchases delivered to the e-station. A smart card system would allow those without credit cards to make e-commerce purchases while delivery to the e-station would resolve problems of arranging for the receipt of goods at home when residents are at work.

E-stations follow the model of traditional train stations, which offered customers a variety of services in addition to comfortable and predictable access to train service. They can also stimulate adjacent mixed-use development in the form of laundromats, newspaper stands, dry-cleaners, daycare centers, drugstores and fast food restaurants. E-stations will be sponsored and maintained by local community organizations in partnership with private entrepreneurs.

why are e-stations needed?

Residents in many inner city neighborhoods depend on local bus service for their transportation. Without private cars and with the expense of taxis, buses are needed to get to jobs, school, medical care, shopping, entertainment, family and friends. Given the loss of stores in many urban neighborhoods, buses become particularly important as a means of fulfilling everyday shopping needs. While bus service itself is often adequate, the experience of waiting for the bus is seriously deficient. In residential neighborhoods, there are often no bus shelters to give protection from inclement weather or a place to sit. There is no indication when buses will arrive and waiting on the street can be unsafe. Improving the predictability, comfort and safety of waiting for the bus is an important aspect of improving public transit.

Why combine computers and internet access with a bus shelter connected to an enhanced transportation system? There are essentially three reasons. The first is to make computers and use of the internet as visible and as easily available as possible. One can see right into an e-station from the street; one can enter and try a computer without making an appointment or discovering the organization's schedule. One can check employment opportunities and reply to them with a resume on a regular basis. In this way, the e-station is consistent with federally funded efforts such as One Stop to make job and social service information available on the internet. Also, one can begin gradually: first using the touch screen format of computers for purchasing bus tickets and then moving on to more involved computer use. The second reason is that by virtue of its location and use as a bus station, the e-station incorporates computers and internet access into people's daily routine, combining them with other tasks and activities (such as bus travel, using the ATM machine, shopping at adjacent stores). Third, the fully developed e-station will allow residents to purchase goods online and, moreover, to have them delivered to the e-station. Shopping on-line can address current needs as many poor inner city neighborhoods lack commercial facilities. Delivery to the e-station solves the problem of the reluctance of private companies to deliver to some urban neighborhoods and can increase convenience for those who are not home to receive packages.

Fig. 1. navigation diagram from e-station website: outer arc — urban network, left circle — transportation network, right circle — social network, lower circle — information network, "e" — e-station, at the epicenter of four networks.

2: INFRASTRUCTURE: CONNECTING FOUR NETWORKS

The e-station is at the epicenter of four larger orders or networks. The e-station is proposed for an inner city community, itself part of an *urban network*. Many community residents are important clients of the *transportation network*, depending substantially on bus

Fig. 2. view of urban fabric from project site.

transportation. In these same communities, residents have limited access to the *information network*; they are on the far side of the so-called ''digital divide'' and many have no computer or internet access. And residents' connection to a *social network* is strained. They are without direct access to commercial and social amenities: supermarkets, pharmacies, doctors, jobs, and counseling.

urban network

The e-station is proposed for a city that is part of a larger metropolitan area. The development of the e-station complements Newark's recent revival. Beginning in the 1990's, numerous projects have started. Beyond the downtown area, there has been significant growth in the residential sector; for the first time in 75 years, the city has had a boom in residential construction. But while housing opportunities have improved, commercial amenities have lagged behind.

The e-station was studied at two contrasting locations: one downtown, adjacent to a commuter train station, the other in a residential neighborhood along a major avenue. Both locations straddle heavily used bus corridors. Students collated passenger ridership and did field surveys during rush hour. Not surprisingly, 60% of embarking passengers were outbound, as inner city residents increasingly seek employment in suburban locations.

The train station location was ultimately ruled out, as it would not qualify for development funds because it was not in a residential neighborhood. The other location qualifies; it is in a residential part of the city and is home to several well-organized, community-based organizations, all are important housing developers and all are trying to restore the city's avenues to prominence as shopping corridors. One of these organizations is seeking to develop a 50,000 square foot supermarket at a point were several bus lines converge. The market would feature parking on its roof, thereby avoiding surface parking and better maintaining the streetscape. The organization is also holding discussions with New Jersey Transit to provide better service and amenities for the supermarket's future patrons. All

team partners — academic, agency and community — agree that the supermarket is the best location for the prototype e-station.

intelligent transportation system

Located in a densely developed area, the city is challenged by growing traffic congestion. The deployment of an Intelligent Transportation System (ITS) will be critical in resolving this problem. These systems integrate computer and telecommunication technologies to assist the operation, development and maintenance of transportation networks. At the e-station, users will be able to make informed choices based on real time bus locations through an automated vehicle location (AVL) system.

Two overlapping AVL technologies will be deployed to support the e-station. The first, EZ-Pass, is an existing, nationally deployed, field-tested ITS technology that can be adapted to determine bus locations: antennas at fixed locations along each route will read electronic tags installed on the bus. Second is the Global Positioning Systems (GPS), the backbone of typical ITS systems. GPS tracks signals from satellites and a centralized home location to establish the location of vehicles to an accuracy of fifteen feet. The combination of these two systems can provide a cost-effective ITS system for the e-station.[2]

Another ITS technology is the kiosk. Kiosks provide real-time travel information, allowing fast access to web-based maps, routes and transportation schedules. Similar to the ATM (Automated Teller Machine), kiosks are now common at large transportation facilities such as airports, offering limited web access in terms of time and content for services such as email and local information. The kiosk will subscribe to a real time trip planning service that is currently available throughout the region, but deployed in only limited locations. According to intelligent transportation professionals, ticket vending machines will merge with kiosks within ten years. Kiosks will employ touchscreen technology, which since the advent of the ATM has evolved as an easy-to-use, intuitive method of interacting with computers. Experts

anticipate that the kiosk will be as revolutionary to transportation as the ATM has been for banking.[3]

The impending adoption of Smart Card technology will only increase the functions available at kiosks. Equipped with an electronic chip, Smart Cards are read through a radio frequency transmission when the card is passed in front of a receiver. Smart Card technologies reduce labor-intensive cash handling costs, permit sophisticated fare pricing, allow for automated passenger counts, and link different transportation networks. Several major metropolitan transportation agencies worldwide are using Smart Cards. At the e-station, the gradual imple-mentation of a Smart Card system into transportation, information and social networks is key for the station's ultimate success. While local transit agency deployment of a Smart Card system is years away the technology is becoming widely used and integrated within credit, bank and ID cards.[4] Smart Cards may be available for use at the e-station even before the transit agency begins using them. Since most poor urban residents are familiar with ATM cards (the ATM-based Family First Network has replaced welfare script) or prepaid phone or cash cards, the introduction of new technology will be more easily accepted. The e-station integrates Smart Card technology allowing the users: keyless access to the building, to the internet, to telecom services, to social services, to pay for bus tickets, retail purchases, and ATM transactions with a single card.

information network

Exclusion from the digital world is what is meant by the term the ''digital divide.''[5] Without access to computers and the internet, minority groups are deprived of significant sources of information and services and prevented from developing the computer skills neces-sary for so many jobs today. The e-station intends to bridge that digital divide by providing services in a graduated manner, first through use at a kiosk, later with better enabled computers in a separate, secure location. This secure space will also be equipped with telephone, fax and e-mail for members of the communi-ty without access to basic telecommunication. Technolo-gy classes will be offered in this secure location.

Once initiated to the internet, a user at an e-station will be able to participate in the world of e-commerce, the fastest growing commercial use on the internet with transactions last year exceeding 37 billion dollars. As reported in the focus group, residents have limited shopping opportunities nearby; they must travel at least 20 blocks for basic shopping and miles for a supermar-ket. Being able to purchase goods on line will increase their choices and reduce the need for traveling. Security

issues keep Fed Ex and UPS from delivering packages to certain poor residential neighborhoods. To redress this, users will be able to receive goods purchased online at an e-commerce depot within the e-station.

Even though new technology eliminates hassles, there is a deep held suspicion, especially in the inner city, of any system that can be mis-used to monitor behavior. Online shopping and e-commerce activities in general are also perceived as threatening privacy. In order to succeed, the e-station must develop an educational strategy to allay these fears. The following must be stressed: the technology that brought us ATM's twenty years ago was greeted with skepticism, today they are widely accepted and allow cash withdrawals worldwide; universal acceptance of Smart Card technology is simi-larly imminent. Identity on the internet is always controlled by the user; passwords, Smart Cards and firewalls keep a person's information private. Informa-tion is only accessible by those who have permission; thirty-seven billion dollars would not have been tran-sacted if fraud were rampant.[6]

social network

In Newark, the e-station incorporates a One-Stop Career Center. These federally funded but locally organized centers develop local workforces in populations with barriers to employment. As the name suggests, One Stop integrates public and private information systems and connects assessment, job counseling, education, training and employment on local and state levels. Connected electronically, centers are typically in de-centralized locations, such as social service agencies, community colleges, schools, vocational rehabilitation programs, and employment programs and community-based organizations. Each has a state-certified vocation-al counselor and networked computers with internet connections. The One Stop program often complements computer training or employment services that are already in place at that location. Locating a One Stop Center at an e-station would have clear advantages: it would make the One Stop services very public, easily accessible and convenient. Currently, the One Stop Centers in the city are not visible to the public and the number of users so far is not as large as anticipated. Having a One Stop Center so visible and so accessible, as it would be in an e-station, could increase its use.

For precedents, the e-station looks to two types of facilities that increase the accessibility of computer services to low-income populations. ''Community tech-nology centers'' provides computer access to people without access to computers or the internet. Such centers may be part of a larger organization such as a

library, job training center or community-based organization or they may be stand alone organizations whose primary objective is to provide access, education and training connected to computer technology. In these centers, access to computer technology is not a goal in itself but rather the means to reach other educational, social or economic opportunities; it is expected that many users will be able to take the skills and knowledge gained to pursue additional education elsewhere or to take new jobs. The e-station is similar to community technology centers, sharing the goal of providing computer access at noncommercial rates to low-income populations in their own communities. However, unlike community technology centers, which are often buried within institutions, the e-station will be directly connected to public transportation with computers easily visible and accessible right from the street.[7]

A "televillage center" also provides computer access as well as education and training in low income communities but it provides those services within a wide array of other functions and is located adjacent to major public intersections so it can become the core of a mix of for-profit, not-for-profit and government facilities. A prototype televillage center, Blue Line TeleVillage, was developed by the Los Angeles County MTA between 1995 and 1997, adjacent to the Metro Blue Line light rail system in the City of Compton. Like the televillage, the e-station is to be located adjacent to a major transportation route, providing easy access to computers directly from public transit.[8]

3: ARCHITECTURE: PROGRAM AND DESIGN

The four networks provide a conceptual framework for the e-station, indicating its integrated components. These components and the needs they generate suggest a series of spatial relationships and physical form for the e-station. Using this programmatic information developed by the infrastructure planning studio, students in the architecture studios developed prototypes of the e-station.

The e-station entrance/lobby is open visually and accessible to everyone. One can wait here, and see the bus display, or under the canopy for the bus. ATMs, ticket vending machines, and information kiosks. The information kiosks are available in the lobby in the entrance lobby provide high volume, short-term access to the internet and travel information. A concierge oversees activities in the entrance lobby from a secure, adjacent location.

Passing through the lobby, one accesses the semipublic e-space. Within the e-space is the computer and telecommunication center, giving full access to the One Stop center and a variety of social, educational, cultural and commercial services on-line. Here, the community can order goods on-line and pick up deliveries of their internet purchases at the e-commerce depot.

A concierge oversees activities in both the entrance lobby and the e-space. He or she is responsible for management and security. The concierge can educate users and coordinate educational seminars and can guide users through the system from one location, entering into any workspace virtually. By scheduling the concierge in two eight hours shifts, the e-station could be open from 6 am to 10 pm, 6 or 7 days a week.

Smart Cards will be phased in as digital keys to the e-space. The Smart Card enables the concierge to maintain the safety and security of those using the e-station. How much personal information the smart card holds is user defined. For those that are still skeptical, a prepaid card like a phone card can be used to provide access, but with certain obvious limitations.

At the focus group, the community stressed the need for a security guard, despite the presence of a concierge, at the e-station. Business owners in Newark have reiterated this point. If the e-station is developed near the supermarket entry, it might share security, which would greatly reduce operating costs. The decision as to when and how long a guard is required and what kinds of technology can secure the facility ultimately rests with the community.
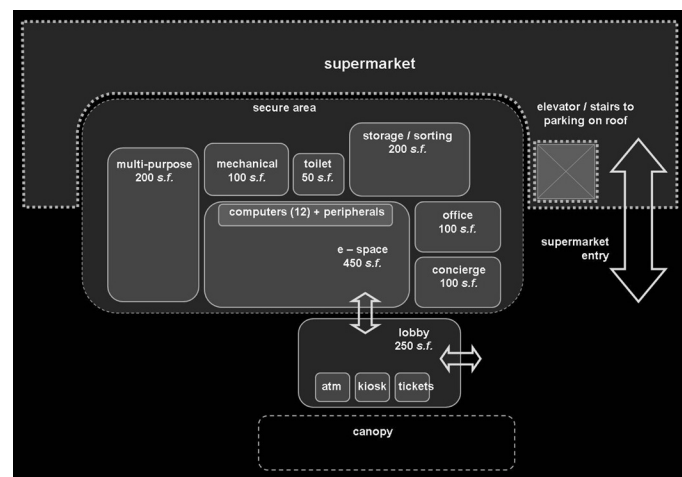

Fig. 3. e-station program diagram.

Students were asked to develop prototypes adjacent to both the supermarket entry and vertical circulation to the rooftop parking. Four prototypes are shown on the following pages.

4: MANAGEMENT: BUSINESS PLANNING

As envisioned in a business plan, the e-station will operate as a public-private partnership. The business component will act as a catalyst for the development of the e-station and will eventually make the e-station self-sustainable and profitable through a steady revenue stream. Under this plan, the e-station would be owned by a non-profit community-based organization. This organization would lease space to one or more businesses occupying the e-station and would receive some percentage of their profit. Additional funding for social services would come from government or private grants. Funding for the construction of the e-station would be in the form of a grant or construction loans through the reinvestment authority.

The business services in the e-station would be centered on the internet and e-commerce. One business could be a cyber cafe, providing internet access on an hourly fee basis at the long-term terminals with vending machines or a refreshment counter and offering additional workshops and classes. Research suggests that ''cyber cafe'' as a designation is more successful than ''computer resources center'' or similar terms. This business would operate its own internet portal, allowing merchants to operate on the portal's web page for a fee, with purchases made through the e-station portal site. In addition to paying for advertising on the e-station portal, merchants selling on-line would pay a percentage of total sales to the cyber cafe that would manage the portal. E-commerce purchases could also be deliv-
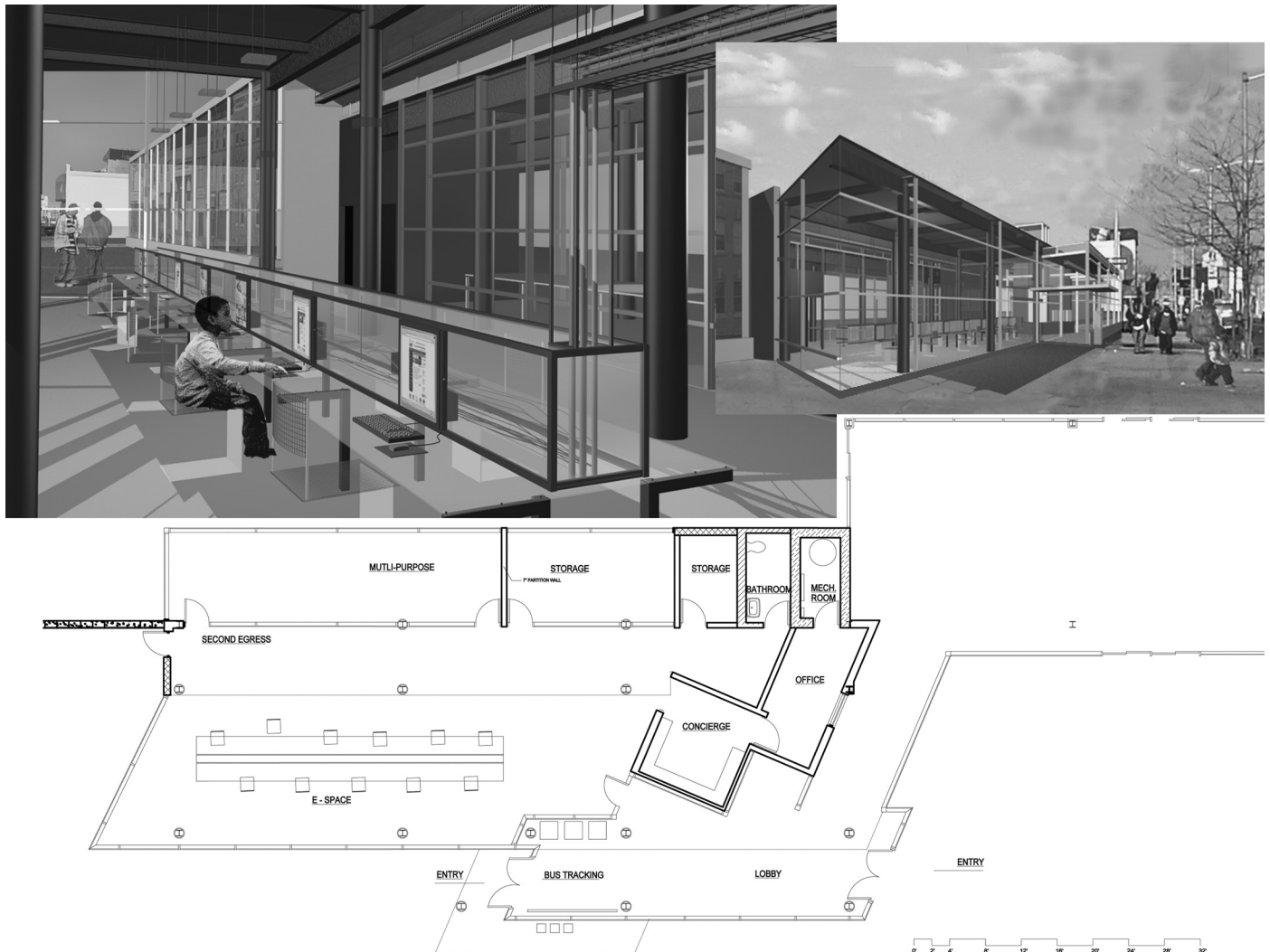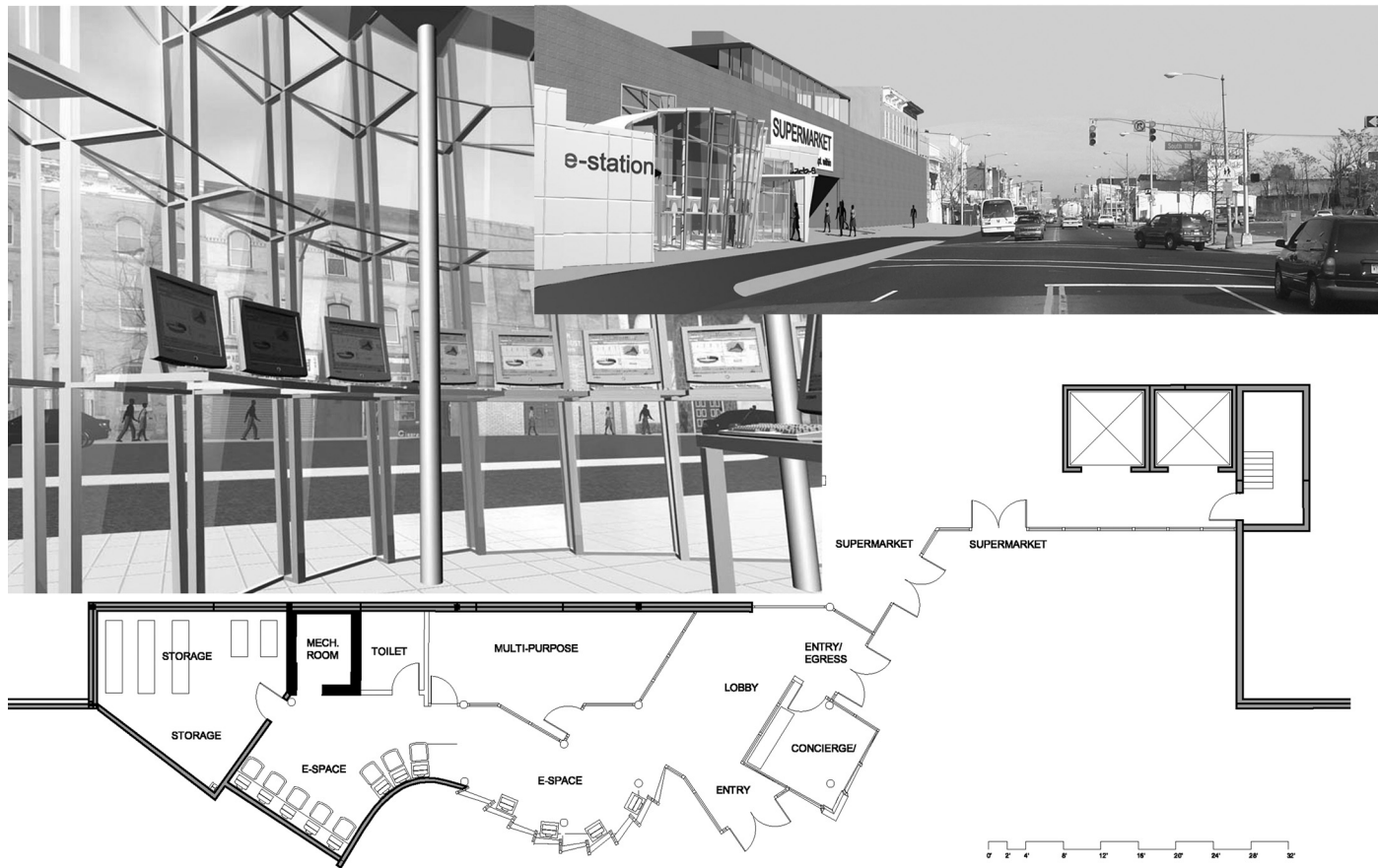

Fig. 4. Student Designer: Ersela Krippa.

Fig. 5. Student Designer: Lennox Brown.

ered to a private mail center operating within the e-station.

Currently Newark has two cyber cafes in other areas of the city; each charges $12 an hour for internet access. Across the street from the e-station site is a small computer business that provides computer and internet access for $5 an hour. The business is a candidate for running the e-station cyber cafe and has expressed interest in doing so. The business analysis indicates that the cyber cafe could fulfill almost all of the responsibilities of the concierge/facilitator and in return would pay a below market rent and would receive 75 percent of the revenue from the portal business.

Management and operating costs are estimated to be $125,000 for the first year, with a 3 percent increase each year over a five-year period. These costs would be covered primarily by base rents received from the two business entrepreneurs in the e-station (cyber cafe and private mail center) and a small percentage of their gross revenue.

All labor costs will be covered by the One Stop program or by the private entrepreneur. The greatest cost is for

security. If the adjacent supermarket guard satisfies the security needs of the e-station, operating costs would be cut by more than half and the e-station would be sustaining in its first year. With its own security guard, the e-station would require additional revenue drawn from advertising, fees from ATM machines and pay telephones, and rental from a 24-hour newsstand to attain sustainability.

5: DEVELOPMENT: ISSUES AND NEXT STEPS

Development of the e-station is ongoing; progress shown here represents Step One. The Community Development Corporation recently received a $400,000 business development grant and has begun to develop the supermarket as part of Step Two. Additional development funds will be required to pay for the construction of the market and the first e-station. The $240,000 designated by the State to develop the e-station is currently frozen due to statewide budget constraints; other means are being sought. In Step Two, as development of the supermarket and fundraising advance and the precise configuration of the e-stations is determined, a student team, using the prototypes as

departure points, will develop a design up to 50 percent design development. A private architectural firm will assist faculty during the student phase, then complete the design and administer construction. The construction manager, currently part of the team, will build the first e-station, after which the Community Development Corporation will operate and maintain it along with their private, for-profit, partners.

The success of the e-station depends fully on its acceptance and use by local community residents. Such acceptance and use requires an intense and well-designed marketing campaign both before and after the e-station is open. The need for education about the e-station and marketing its benefits was raised by residents in the focus group and stressed in the business plan. At the appropriate time, marketing students in the School of Management will assist a private marketing consultant in these efforts.

In the next phase, the specific legal arrangements regarding responsibilities, assets and liabilities between the development corporation, the private entrepreneur/operator and the One-Stop program will have to be finalized. CTCnet has a program that assists in these arrangements and also trains staff.

The e-station is part of the larger concept of bus rapid transit. Newark, which developed along trolley lines and has a consistently high bus ridership, is an excellent candidate for the application of bus rapid transit. NJ Transit is currently considering deploying features of bus rapid transit along the bus corridor served by the e-station.

NOTES

[1] Research for the e-stations project was conducted with my two colleagues at NJIT, Karen Franck and Tony Santos.
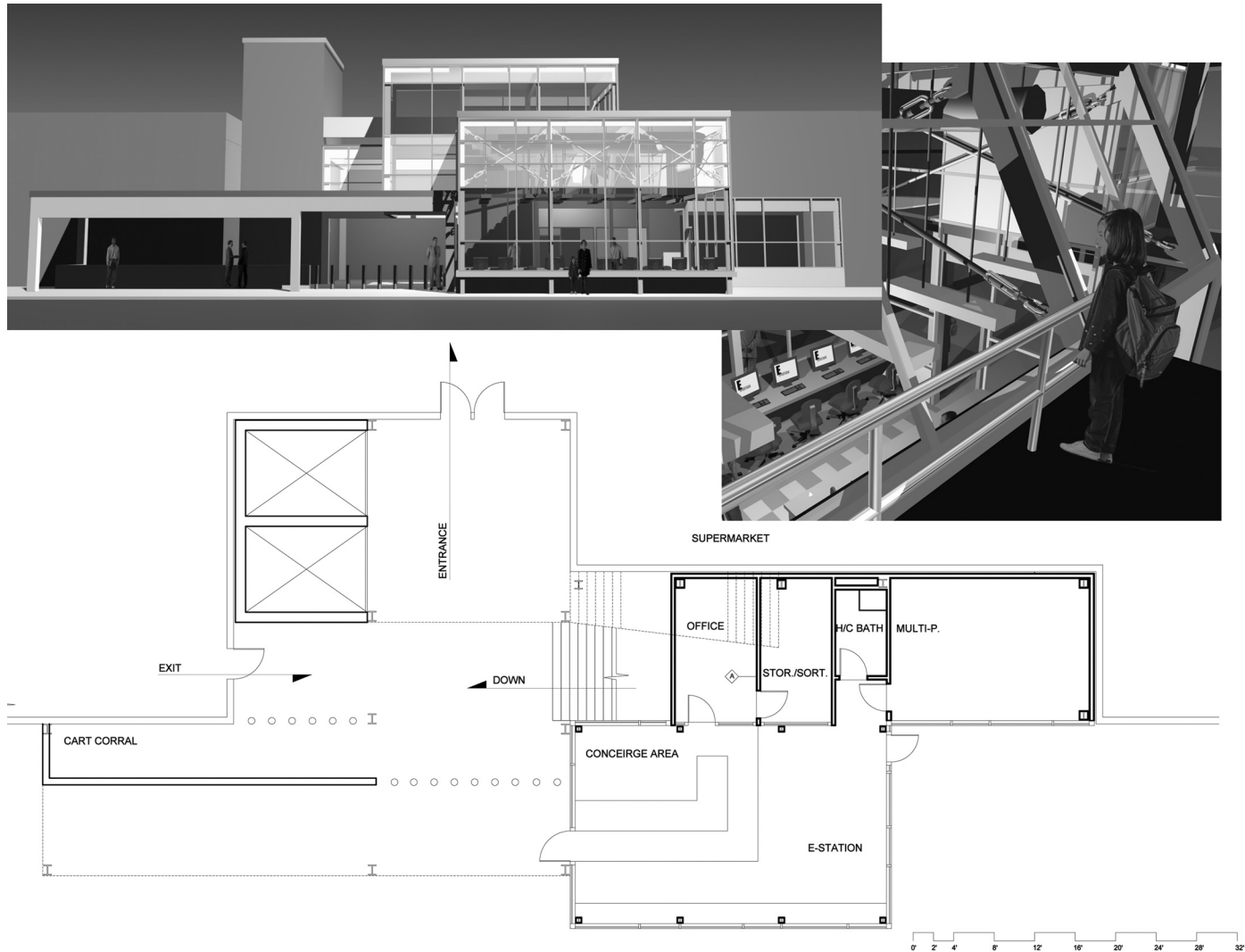

Fig. 6. Student Designer: Eric Miller.

Fig. 7. Designer: Joe Delucia.

[2] The ITS merits of GIS versus EZ-Pass are discussed in *the* National Research Council (U.S.). Transportation Research Board, *Evaluating Intelligent Transportation Systems* (Washington D.C.: National Academy Press 2000)

[3] Transcom's Traveler Itinerary Planning System (TRIPS123) (www.xcm.org)

[4] An embedded computer chip in the card stores information and electronic cash. Encryption technology, currently used in credit cards, maintains the safety, security and privacy of the user. This technology controls access to specific information by particular parties. The reader device (RD) only accesses a prepaid fare. The RD access for a space only reads the entry code. Unauthorized use automatically destroys the card. See Rinaldo Di Giorgio, ''Smart Cards, A Primer,'' Java World (December 1997) www.javaworld.com

[5] Between 1998 and 2001, Internet access rose from 31 to 54 percent in all households in the U.S. However, the increase among African American households was only 11 to 33 percent. In the third quarter of 2001, over half the U.S. population was using the internet at home but only 30 percent of Hispanics and 33 percent of African Americans were doing so. www. digitaldividenetwork.org

[6] It is a common fear that information stored electronically could be used without authorization. Participants in the focus group reported that privacy is a major concern. Some said they were reluctant to use credit cars, even if they were available and prefer the anonymity of cash. Several group members gave accounts of friends or relatives who received speeding summons because of EZ-Pass. Given that the transportation authorities have never authorized police to do this suggests that this is an ''urban myth.''

[7] The Community Technology Centers' Network (CTCnet) has provided essential support and guidance in the establishment of such centers since the early 1980s and is committed to their development. Their manual is a comprehensive guide for development. See: Antonia Stone, Centers Start-Up Manual (Cambridge Massachusetts; Education Development Center, 2000)

[8] The 2,500 square foot space was located in the city-owned Transit Center and contained a computer center, a video conference center, a telework center, two kiosks for the local housing authority, two ATMs, and a community meeting room. The Transit Center contained the Compton Chamber of Commerce, a police sub-station, a day care center, a Head Start program, a number of retail outlets and the City of Compton's Business Assistance Center. The televillage has been less than successful. Counter to the originator's recommendation, the televillage was owned and operated by the municipal government and not by a community non-profit. The City of Compton has starved the center for necessary funds, which underscores the need for financial independence at the e-station. See Walter Siembab and Thomas O'Brien, ''Digital Broadband Networks for Economic Development and Mobility: A Bricks and Bits

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CyberTran	www.cybertran.com/
Digital Divide Network	www.digital divide.org
Intelligent Transportation Infrastructure Deployment Database	www.itsdeployment.ed.ornl.gov/
MIT Intelligent Transportation Systems	www.hippo.mit.edu/
The University of Michigan ITS Education Program	www.its.engin.umich.edu/.html
The Directory of Transportation Resources	www.dragon.princeton.edu/~dhb/
ITS America	www.www.itsa.org/
City Of Bits	www.mitpress.mit.edu/