VISUALIZING METRA: AN INTERACTIVE VISUALIZATION TOOL

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ABSTRACT

An interactive visualization tool, Visualizing Metra, was developed for Metra, Chicago's regional commuter rail system, to support decision-makers in different departments requiring information about Metra's stations, lines, ridership, land use, surrounding stations and connections to other transportation facilities. The application was developed as an intranet application in Macromedia Dreamweaver with a scalable base map with embedded links. The application allows the user to navigate visual, quantitative and text data.

The strength of the application lies in its design. The design developed a template for each level in a spatial hierarchy providing a consistent approach to accessing information based on scale. Each level provides access to many different functions with common headers for navigation. The main frame has a GIS map of the station and surrounding suburbs. A zoom tools allows the user to see more or less detail. The secondary frames include track video and a slide show of the station area. The track video is accessible by clicking on the secondary window or on the video icon in the main window.

Functions available at other levels include:
* System level - ability to navigate directly to a line or station
* Line level - zoom tool and ability to navigate directly to a station via a list or the map
* Station and nearby blocks level - aerial photographs, socioeconomic data for the community
* Station level - access to detailed Autocad representation of station information, and navigable station panoramas
* Station building level - parking information

The prototype was developed in collaboration with Metra staff to address their needs for access to and display of information. The presentation describes the system from the point of view of the various users.

INTRODUCTION

Successful planning, development and management of transportation infrastructure and fixed rail networks in densely populated urban areas requires the development of a shared contextual and conceptual understanding of the relationships between transportation and land use, including demographic, economic development, and ridership trends. From the perspective of a single agency such as Metra, the commuter rail system for the Chicago region, the agency must be able to closely align their own plans for growth and development with external trends as well as planning decisions made by different planning agencies in the region. Metra's eleven lines and over 230 stations serves the diverse populations of Cook, DuPage, Lake, Will, McHenry and Kane counties. Then within Metra, individual departments in the agency (e.g., planning, engineering, operations, and marketing) must become familiar with the data demands and analytical approaches of other departments in order to develop a better appreciation of how the agency can fulfill its organizational mission. The challenge is even greater because agencies such as Metra often collect data and information for various purposes over time and this information is often not housed in the same department in the organization or the same digital location.

Consider an issue such as increasing Metra ridership: the department of planning is likely to consider a five year timeline and focus on expanding ridership by better management of park and ride options around those stations where residential development is projected to grow. On the other hand, the marketing department is likely to focus on a system-wide education and promotion campaign. The

engineering department's approach to increasing ridership may be to make facility upgrades. Also, Metra may choose to work with municipalities to upgrade stations in areas of potential growth, projects that may extend over several years. These departments need to have access to data and information relevant to their needs. Planning may need information related to the neighborhood around individual stations and the availability of parking spaces at different times of the day in order to better understand demand for parking and changes in ridership trends. Engineering may need very precise and specific information about the quality of the track, and the physical infrastructure of the station in order to make decisions about station upgrades. Thus, different departments will require the same information about Metra stations, coach yards, location of rail line infrastructure, land use patterns, and ridership profiles, though not all information will be immediately relevant to each department's specific needs. At the same time, engineering may occasionally need to understand the planning and marketing perspective and vise-versa.

This paper documents the development of a shared conceptual framework supported by visual representations, and organized and codified according to the needs of the agency are useful for data organization and collaboration within and across different departments in an agency. We propose that the visual representations allow users from different departments (who tend to work at different spatio-temporal scales) to understand and appreciate complex problems from alternative perspectives. The interactive visualization tool developed for Metra, henceforth called MetraViz, was developed to support decision-makers in different departments requiring information about Metra's stations, lines, ridership, land use, surrounding stations and connections to other transportation facilities. Disseminating meaningful information for distinct groups of users requires careful attention to data organization and display so that the user can assemble and analyze data most appropriate to their immediate decision-making needs.

This paper is organized as follows. The following section discusses the design philosophy. The design template is then described and the prototype application presented. Finally future directions are outlined.

APPLICATION DESIGN PHILOSOPHY

MetraViz is a computer-based "navigable visualization" prototype application that provides different departments within Metra a way to organize, view and present relevant information in an easily navigable format using accessible technologies. MetraViz uses an interface similar to that of a conventional web page and can be loaded on individual computers or on an internal data network. The application includes maps, interactive vertical and horizontal views of the station and its surroundings, aerial photographs, and other visual and non-visually represented data.

Application design was preceded by a period of consultation with Metra staff in order to determine a user typology for the agency. The research team determined that a tripartite user typology (represented in) that groups users into three categories (Planning, Engineering/Operations, and Marketing) could accommodate the diversity of data demands and research needs of the organization. Although these user typologies are synonymous with departmental groupings, it should be noted that the system is accessible to users in all departments.
The interactive interface of the tool includes text and icon-based navigation. A geographic, scalable base map with embedded links allows the user to navigate to visual, quantitative, or text data that appear on separate windows within the application. The changing scale (geographic boundary) of the base map allows the user to visualize and access data that is appropriate to that scale.

MetraViz's goal was to help organize and share information that is immediately meaningful to the demands of a particular department. This requires the designers to consider how different users assembled and organized data and the kinds of analyses that were most frequently needed for a particular purpose.

In order to demonstrate the flexibility of our system, we included information related to technical specifications, parking, economic development, and design considerations. For example, Metra's internal planning department can use this site to access parking data at one of the stations or to access economic development data around a particular Metra station. A facilities manager may use this site to determine

station building maintenance needs. An engineer or operations manager may be able to use the site as a tool to view the right of way from one station to another or to link to relevant facilities data in a pre-existing application, Operations Profile (OPS-PRO).

All the elements are interactive - for example, maps have elements which when clicked bring up information on parking, accessibility, or photographs and aerials of the station and nearby elements. In the course of designing and developing the Metra Visualization tool, careful attention was paid to issues like levels of scale and providing for the needs and requirements of different types of users. Planners and decision-makers in large organizations require access to different types of data and information, typically collected for different purposes by several departments over a period of time. Some of this data is scale-dependent, while other pieces of data and information are scale-independent and therefore likely to be useful in different decision-making contexts.

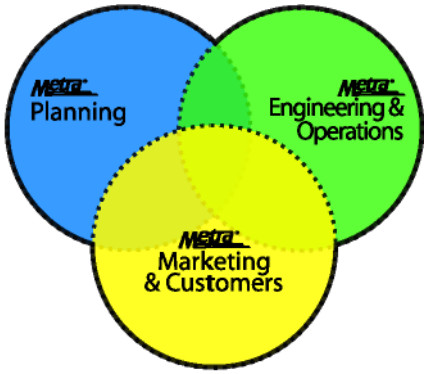

Figure 1. Metra User Typology

Eventually, Metra customers may access portions of this site. A customer would be able to determine information such as transit connections at a station, or restaurants within walking distance of a station by using this application.

THE DESIGN TEMPLATE

The design template provides a framework for the prototype application that is extensible, scalable and flexible. The template focuses on keeping the user oriented within the visualization system by exploiting the logical spatial hierarchy from system to line to station, and a consistent layout of frames on each individual page. Figure 2 shows the spatial hierarchy for the Tinley Park Station on the Rock Island line. Each level of the hierarchy is represented by a webpage that is linked to the previous and following levels of the hierarchy.

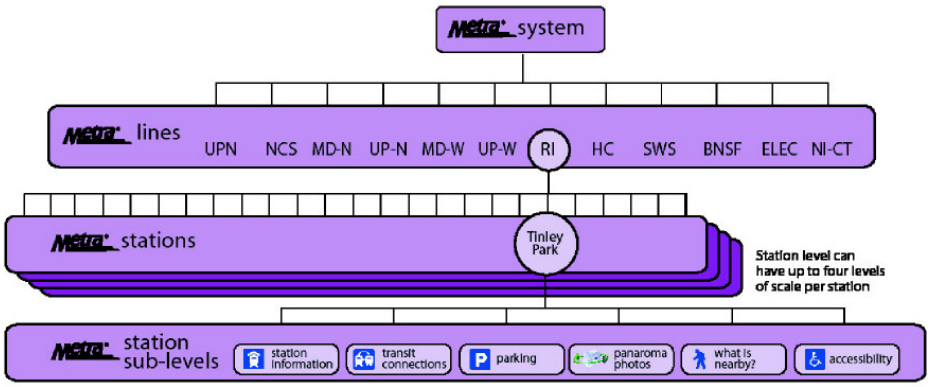

Figure 2 Framework for the Design Template

Each station may have up to 6 sub-levels that have data that is station specific. Figure 3 shows the standardized page layout with the browser navigation bar at the top of the page, the main navigation bar under that, a station navigation bar immediately under that, a secondary navigation bar at the bottom of the page, and three frames in the center of the page. The three frames in the center of the page are typically a map with clickable icons, and two frames depicting detailed information linked to the clickable icons in the main frame.

The main navigation bar provides links to data and systems external to MetraViz, Metra's homepage, Northeastern Illinois Planning Commission's (NIPC) development database, the Regional Transit Asset Management System (RTAMS) maintain by the Regional Transit Authority (1), and OPS-PRO (Metra's integrated systems for facility information).

The secondary navigation bar provides an alternate way of navigating through the levels of SYSTEM, LINE and STATION and through station sublevels. The number of sub-levels per station vary according to the amount of data appropriate and available.

The station navigation bar has six clickable links to new pages that give data specifically related to the station the user has chosen. This includes elements like station name and address, links to transit connections like Pace feeder buses, parking, panoramic photos, and accessibility. In the main frame, a zoom tool allows the user to see more or less detail.

Functions available at other levels include:

- System level - ability to navigate directly to a line or station
- Line level - zoom tool and ability to navigate directly to a station via a list or the map
- Station level and surrounding suburbs – a map of the station in the context of the surrounding suburbs with clickable icons that link to track video and a slide show of the station areas.
- Station and nearby blocks level - a map of the station in context of the immediate neighborhood with clickable icons and transit connections, annotated aerial photographs and socioeconomic data for the community
- Station level - detailed map of station extents with clickable icons, navigable station panoramas and access to the Operations Profile (OPS-PRO) station pages
- Station building level - access to information about building amenities and maintenance and station contact numbers

The design template was created to support the incremental development of the system so additional lines and stations could be added as resources became available. Online help functions are provided to explain to the user specific selections and to guide navigation. Two manuals, a "Design Intent Manual" and a "Technical Manual" have been developed. The Design Intent Manual is a guide to adding content to the Visualizing Metra prototype. The manual documents the rationale for the layout of each level of the prototype and explains its function, features and content. It is *the what, the where and the why*. The

Technical Manual provides the "how-to" on extending the prototype and make changes to update the elements. It is *the how.*

The template has been used to develop a prototype application for two stations (Tinley Park and 211st on the Rock Island and Metra Electric Lines respectively. The following section illustrates the application of the design template.

PROTOTYPE APPLICATION

Implementing a new station, or a new line and station requires the some initial preparation in terms of acquiring and enhancing the relevant images and maps, the replication of the existing file structure, and then the replacement of the replicated files with new images, data and information. The Technical Manual documents this process, provides guidance on the appropriate resolution of images for particular applications, and provides links to software for developing specific applications. The design template was implemented in Macromedia Studio MX Suite Dreamweaver to support the linking functions through rollovers, and hyperlinks.
The prototype application opens with the system level map as shown in Figure 5. Rolling over the line on the map or selecting a specific line on the menu to the right opens up the line level window shown in Figure 6. Rolling over the station on the map or selecting the station from the window at right can select a specific station. The initial station level webpage for Tinley Park is shown in Figure 7 and more detailed parking information is shown in Figure 8.

WHERE TO NEXT?

The prototype has been developed to serve as a template for other lines and stations. The evaluation of the prototype occurs at three different levels:
1) Does it work?
2) Can it be extended and updated?
3) Is it useful?

Our research has addressed the first two questions. Our research team has extensively tested the prototype on different computers and in different environments. We have demonstrated the system to our Metra collaborators. The system provides easy access to diverse types of data, visuals, maps and information. The initial intention was for Metra employees to access the system over the Metra intranet. We estimate that with experience a user can add 2 stations every 6 days including data collection. The majority of the time is spent in organizing the information, taking photos, producing and annotating maps, and editing schematics. Unfortunately, Metra is no longer actively pursuing this system. Metra has determined that the system's potential benefits did not match the demands of cost and manpower associated with the creation and data management of this system. Further research may prove useful in identifying a solution which incorporates the lessons of this project in a format that facilitates the updating of information.

REFERENCES

(1)Yoder, S.L. and DeLaurentiis, J, "The Framework for a Regional Transit Asset Management System," ITE Journal, Volume 73, No 9., pp 42-47, September, 2003.

ACKNOWLEDGEMENTS

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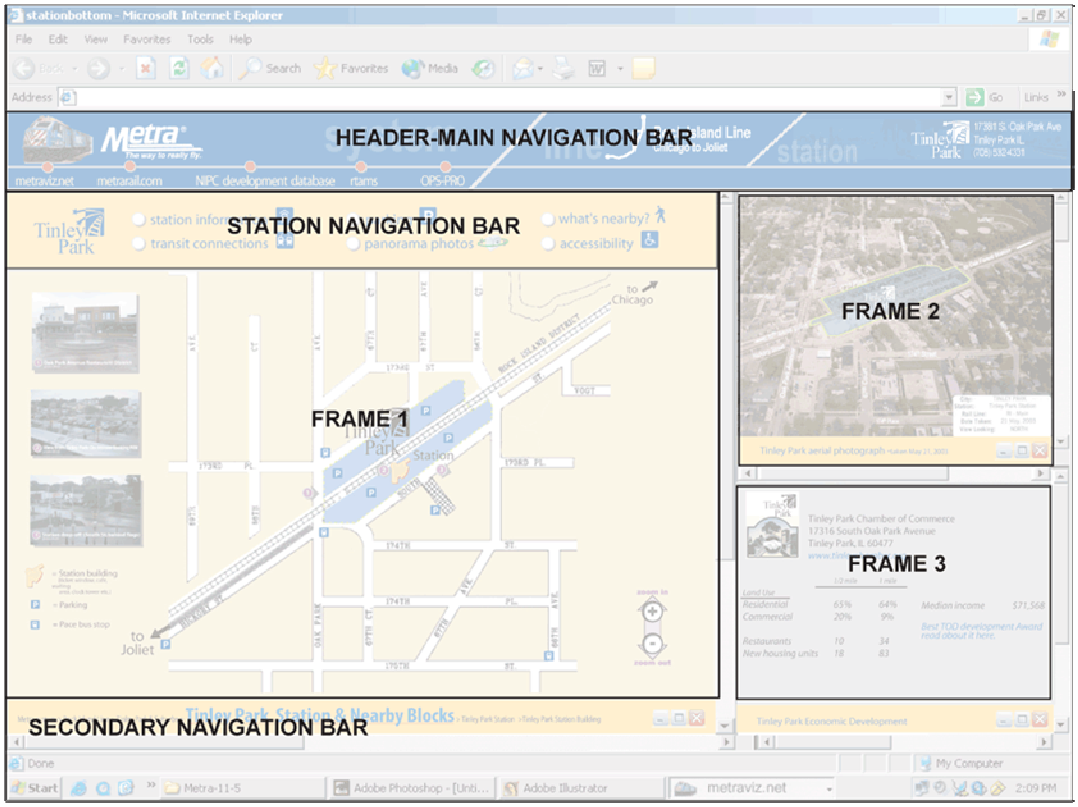

Figure 4. Framework of a Page

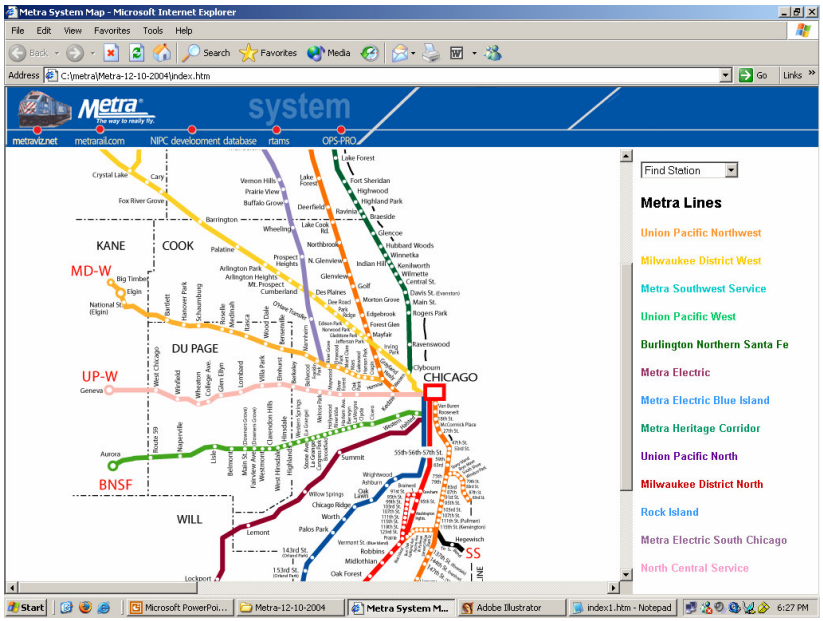

Figure 5. MetraViz System Map

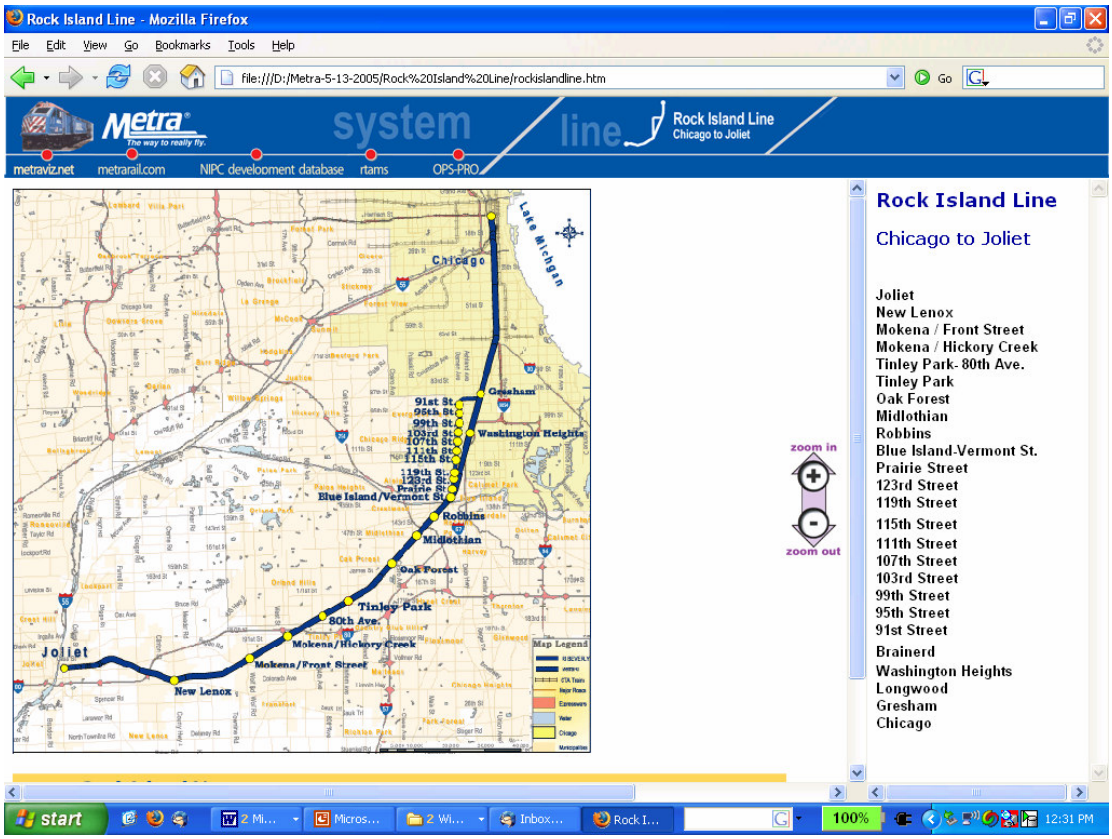

Figure 6. Line level window.

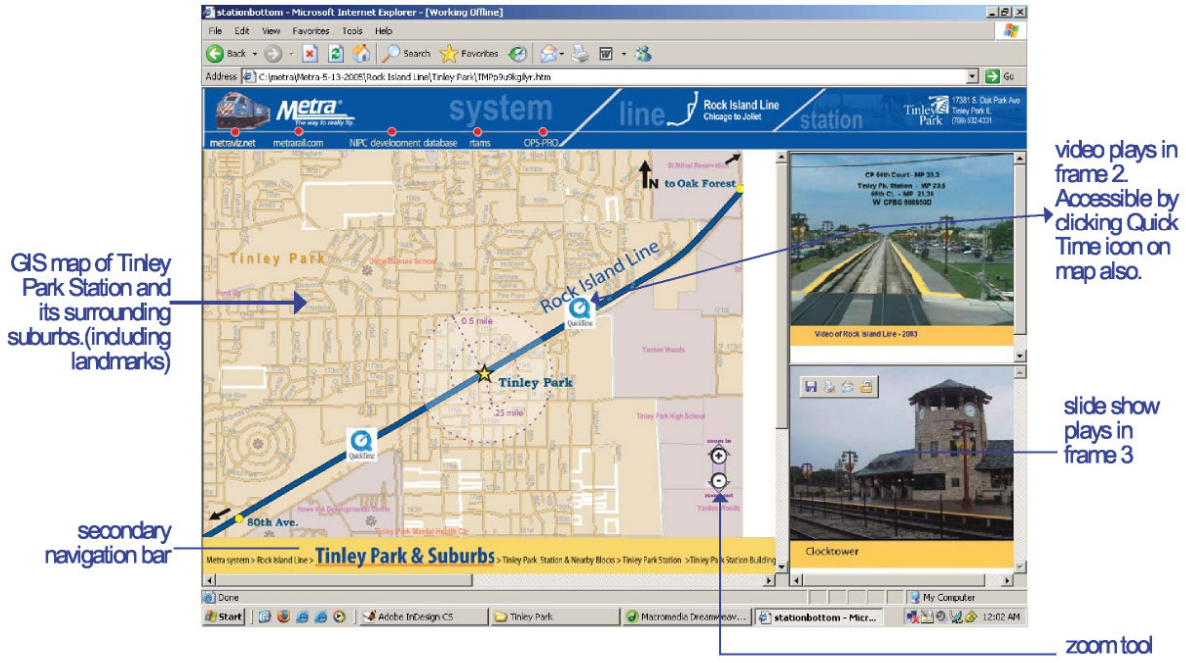

Figure 7. Tinley Park Station and Surrounding Suburbs

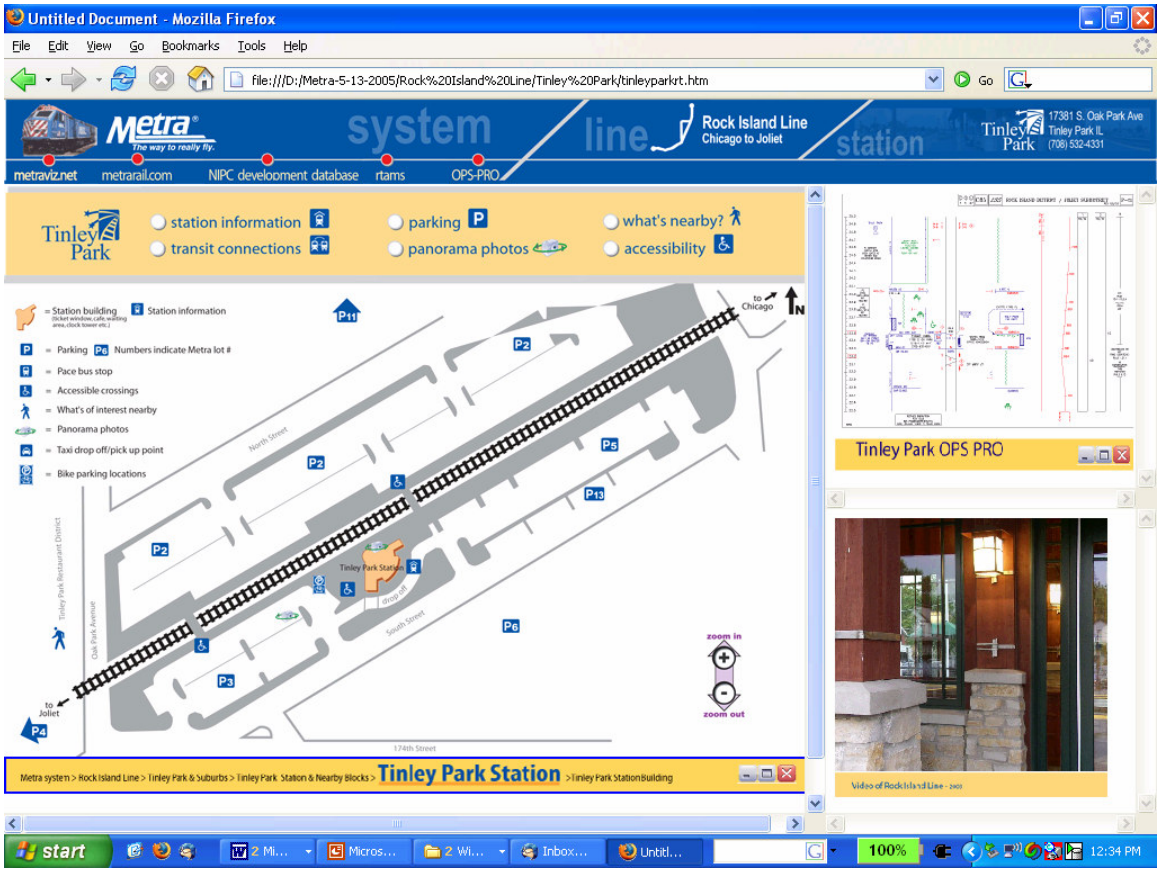

Figure 8. Parking at Tinley Park Station