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MONITORING URBAN AREAS USING VISUAL DATA TRANSMISSION TECHNIQUES

CORTUS T. KOEHLER
California State University, Sacramento

ABSTRACT

Several visual data transmission techniques are combined to monitor natural changes and man-made alterations of the urban environment. Aerial U-2 LANDSAT photographs and transparent overlays are used to analyze patterns of change and to assist in infrastructure planning for urban areas.

Historically, the location of cities has been determined by the following: 1) access to water transportation or overland routes; 2) protection from mother nature; 3) security; 4) ample water supply; 5) usable resources for life sustaining functions; and 6) a foundation for construction [1]. As man and time evolved, the evidence of settlement history revealed man has utilized some or all of these factors in his development of urban areas.

In the development of the urban area, the general plan needs to utilize information and projections of both the natural and man-made environments; and to illustrate their synthesis into a combined pattern of actions and objectives over time to create the best benefit of the area as a whole [2]. Above all, this data must be kept current to serve as the basic analytical simulation of the urban area and to become the reference for discussion and decisions concerning different environmental matters [1, p. 19]. In doing so, the future plan of the area becomes one of advancement and optimum land use instead of a battle over the restructuring of what remains. Therefore, it is the purpose of this article to present several visual data transmission techniques combined in one facility where one can monitor the alterations of urban areas by man using two major features—mounted aerial U-2 LANDSAT photographs and a visual aids display case which houses a transparent overlay system.

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U-2 LANDSAT (AERIAL) PHOTOGRAPHS

Figure 1 illustrates the layout of the visual data transmission facility as constructed and utilized by the School of Business and Public Administration at California State University, Sacramento. Three different pairs of aerial maps (a total of six maps) have been placed on the walls of the facility. Each pair consists of a composite map depicting a specific area in the year 1972 (the first year in which LANDSAT photographs were available) and the second map depicting the same area in the year 1980. The photographs, obtained from the U.S. Geological Survey's EROS Data Center, were taken by the Geological Survey's LANDSAT satellites and NASA "U-2" aircraft. The "U-2" photographs were taken at an altitude range of 50,000 to 60,000 feet. The scale of these false color infrared photographs is approximately 1:130,000. (The amount of detail that can be determined, of course, depends upon the scale and altitude at which the photographs were taken.)

The two composite maps, each measuring 8′ × 8′ can clearly depict the land use changes that have taken place in the Sacramento Metropolitan area from 1972 to 1980. The following land use categories can be identified from the maps. These are:

Residential	Commercial and Services
Utilities	Extractive
Industrial	Strip and Clustered
Mixed	Open and Other
Golf Course, Cultivated Grass	Rye Grass
Deciduous Forest	Coniferous Forest
Mixed Forest	All Water Areas
Non-forest	Beaches
Sand, Other Than Beaches	

Of course, aerial photographs can be used for other uses more specific to the needs of an urban area. Specifically, a pair of maps can be used to show how much growth has occurred in a particular area from the year 1972 to 1980 and the resulting growth pattern. By analyzing the emerging pattern, one can attempt to determine future population densities, land uses, transportation corridors, and infrastructure needs for the urban area under investigation. Listed in Tables 1, 2, and 3 are some examples of features that can be identified.

Table 1. Transportation Features to Look For on Aerial Photographs

Freeways	Waterways
Major and Secondary Highways	Railroads
Airports	Local Streets

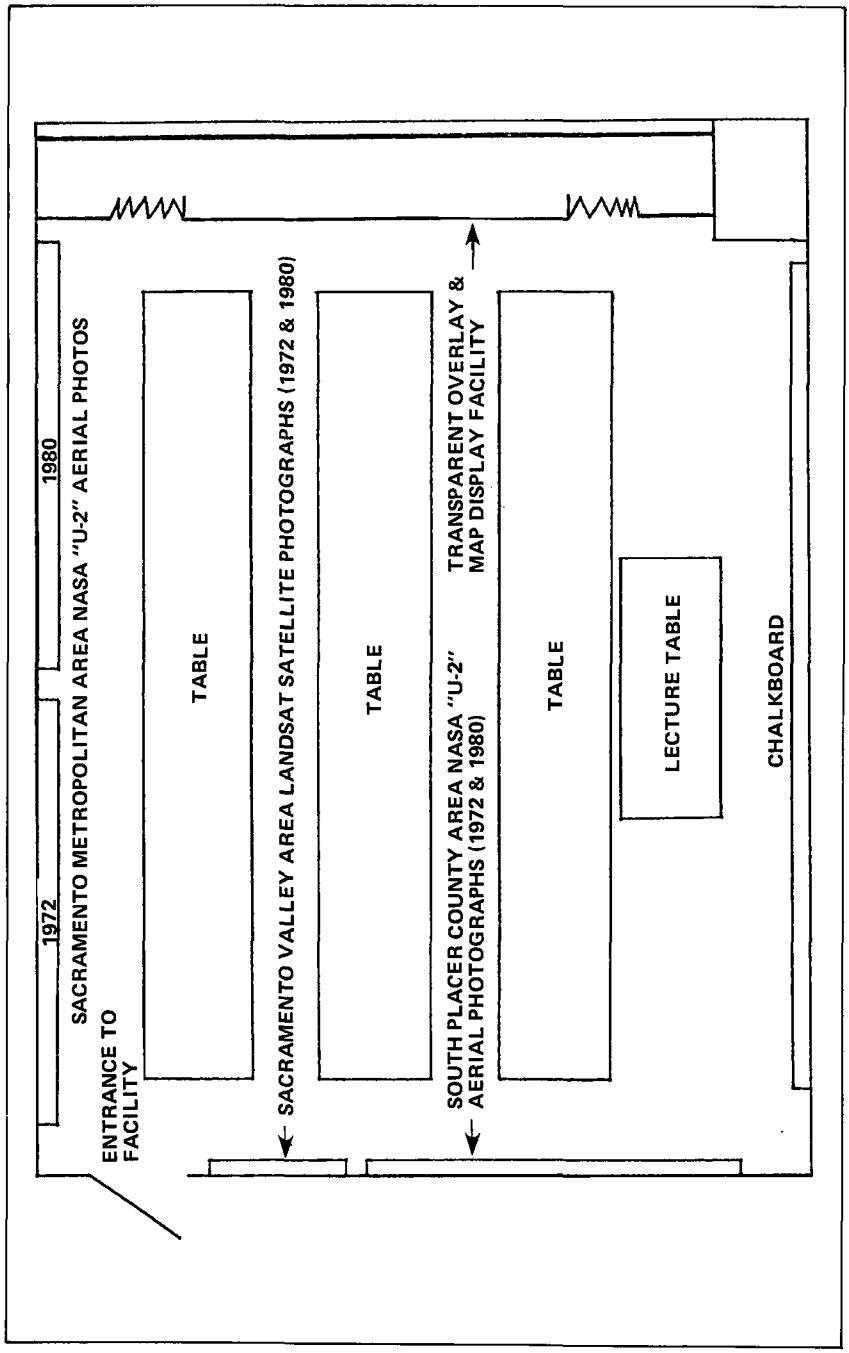

ENTRANCE TO FACILITY
SACRAMENTO METROPOLITAN AREA NASA "U-2" AERIAL PHOTOS
1972
1980
TABLE
SACRAMENTO VALLEY AREA LANDSAT SATELLITE PHOTOGRAPHS (1972 & 1980)
TABLE
SOUTH PLACER COUNTY AREA NASA "U-2" AERIAL PHOTOGRAPHS (1972 & 1980)
TRANSPARENT OVERLAY & MAP DISPLAY FACILITY
TABLE
LECTURE TABLE
CHALKBOARD

Figure 1.

Table 2. Land Uses That Can Be Determined on Aerial Photographs

Heavy Industry (Factories, Refineries etc.)	Residential (Homes, Additions to Buildings, Mobile Home Parks
Light Industry	Resort, Recreation
Commercial/Office	Agricultural
Institutional	Extractive Operations
Utilities	

Table 3. Other Features That Can Be Seen on Aerial Photographs

Earthquake Faults	Beach Erosion
Road Conditions	Open Space
Building Code Violations of Unlawful Changes to/or for Land Use	Forests
	Water Areas
	Prehistoric & Historic Sites

Thus, one can see that the aerial photograph is a way of portraying the urban area as a whole, visualized in its entirety. Also, one can see various kinds of information, detailed pictorially and supplied inferentially [1, p. 89].

THE TRANSPARENT OVERLAY SYSTEM

A land use transparent overlay system is one where a specially prepared sheet of clear plastic is placed over a base map to higlight or outline a specific area(s) on the map. Figure 2 illustrates this process. The areas which the plastic sheet highlights show characteristics that are of special interest. For example, the dotted areas in Figure 2 could represent locations in the State of California where industrial growth is occurring.

If more than one transparent overlay is used, the possibilities for highlighting different factors on the base map are also expanded. Figure 3 is an example of

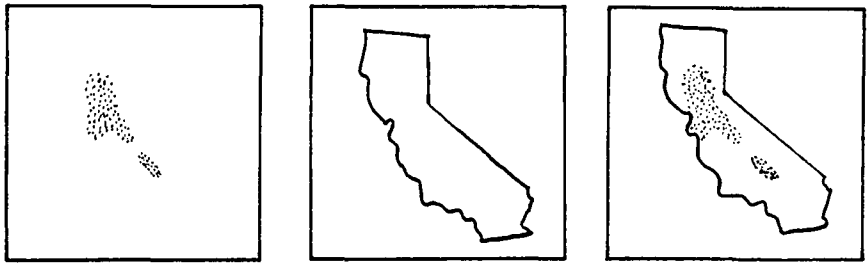
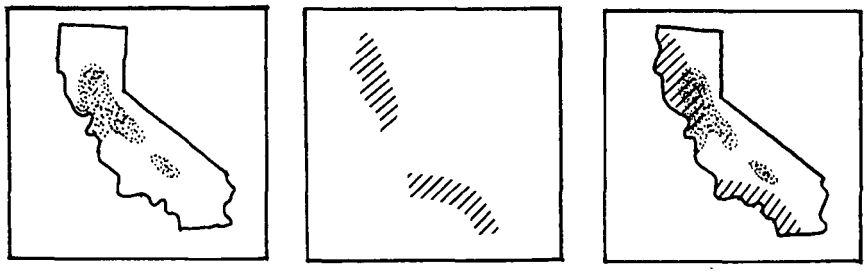


Figure 2.



Map of California Transparent Plastic Sheet A Placed Over It

Second Transparent Plastic Sheet (Sheet B)

Map of California With Transparent Plastic Sheets A and B Placed Over It

Figure 3.

how more factors can be highlighted with the use of a second overlay. The slashed lines represent a second characteristic of interest, for example, areas in the State of California where the average price of a three bedroom home is between $80,000 and $100,000. Areas where the dots and slashes overlap represent locations which, in this example, represent both a growth area for industry and where a three bedroom home can be purchased for between $80,000 and $100,000.

VISUAL AIDS DISPLAY CASE

A visual aids display facility was constructed to house the transparent overlay system. As shown in Figures 4 and 5, a visual aids display facility, measuring 20′ X 9′4″ occupies one wall of the room. The space inside the case used to display maps, photographs, and drawings measures 5′6″ X 15′4½″. This height and width was found to be the best as the majority of maps used by cities and counties are approximately 4′ X 5′. The visual aids case can easily display three 4′ X 5′ maps at one time.

The display facility uses two different types of plastic mediums for the transparent overlay system–3/16″ clear acrylic sheets and .010 (10 mil.) thickness clear mylar polyester film. These two types of plastic can usually be found in any store specializing in plastic materials. Figure 6, a front elevation of the facility, describes some of the display unit's features and shows how an acrylic panel can be placed over a base map on display. One or more transparent mylar overlays, constructed as shown in Figure 7, may also be hung over a base map.

Mediums used to create factors on the acrylic and mylar overlays include graphic art tape, nonpermanent art markers, and sheets of specially treated transparent overlays used by artists such as "Zip-a-tone" or "Panatone" by Letraset. These transparent sheets are available in several designs such as dots and slashes, or in colors. If colors are used to create the transparent overlay system, it has been found that yellow, blue, orange, green, and brown are the best suited as they create finer color distinctions. For example, referring back to

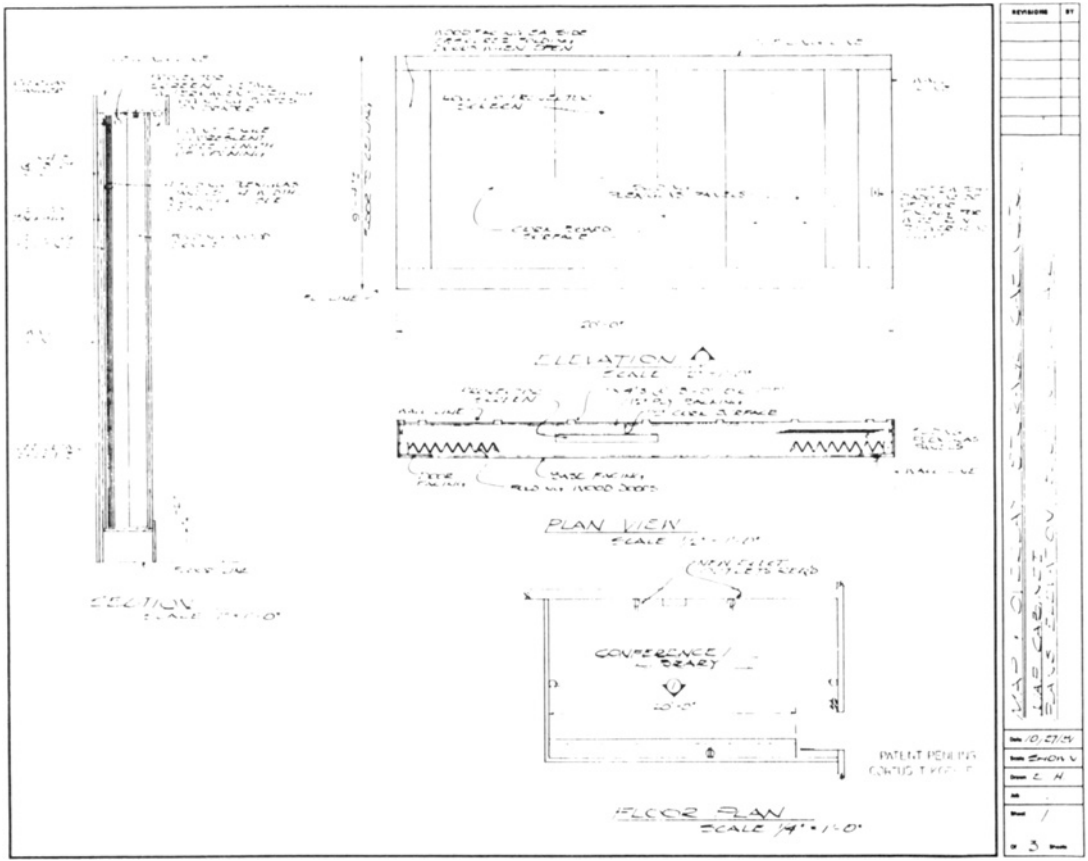


Figure 4. Plans for visual aids display case.

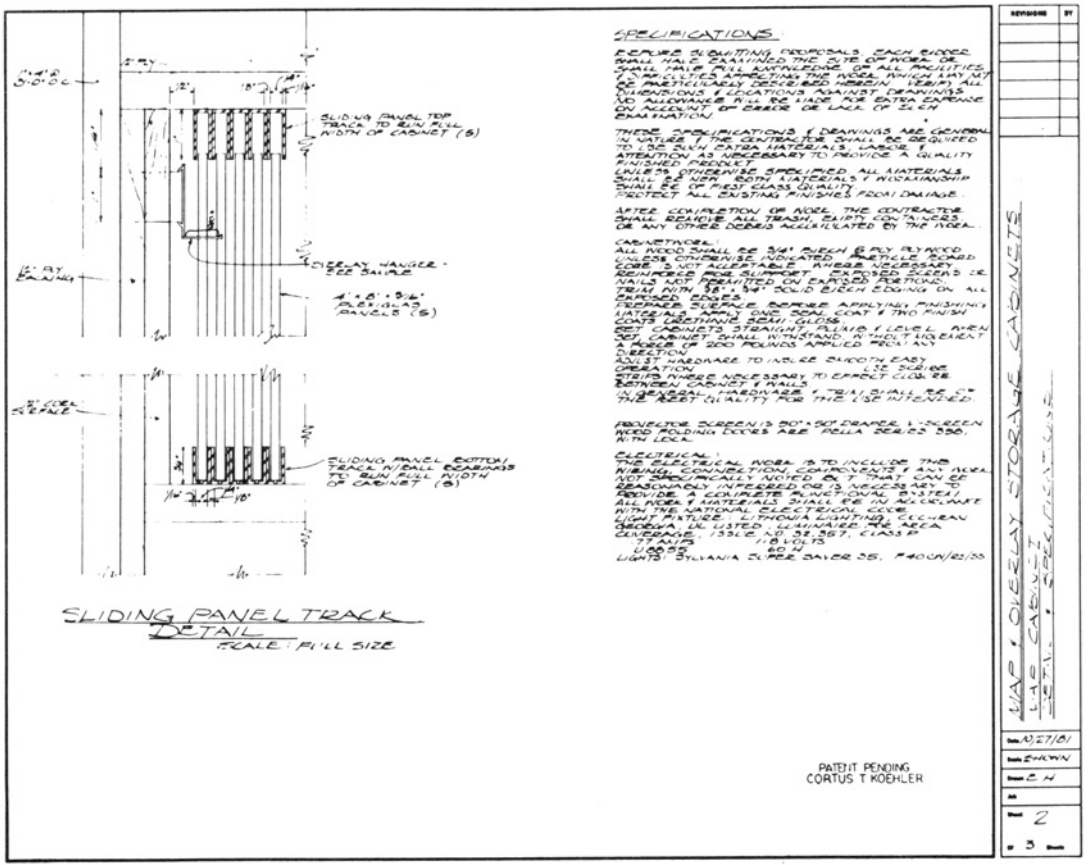


Figure 5. Plans for visual aids display case.

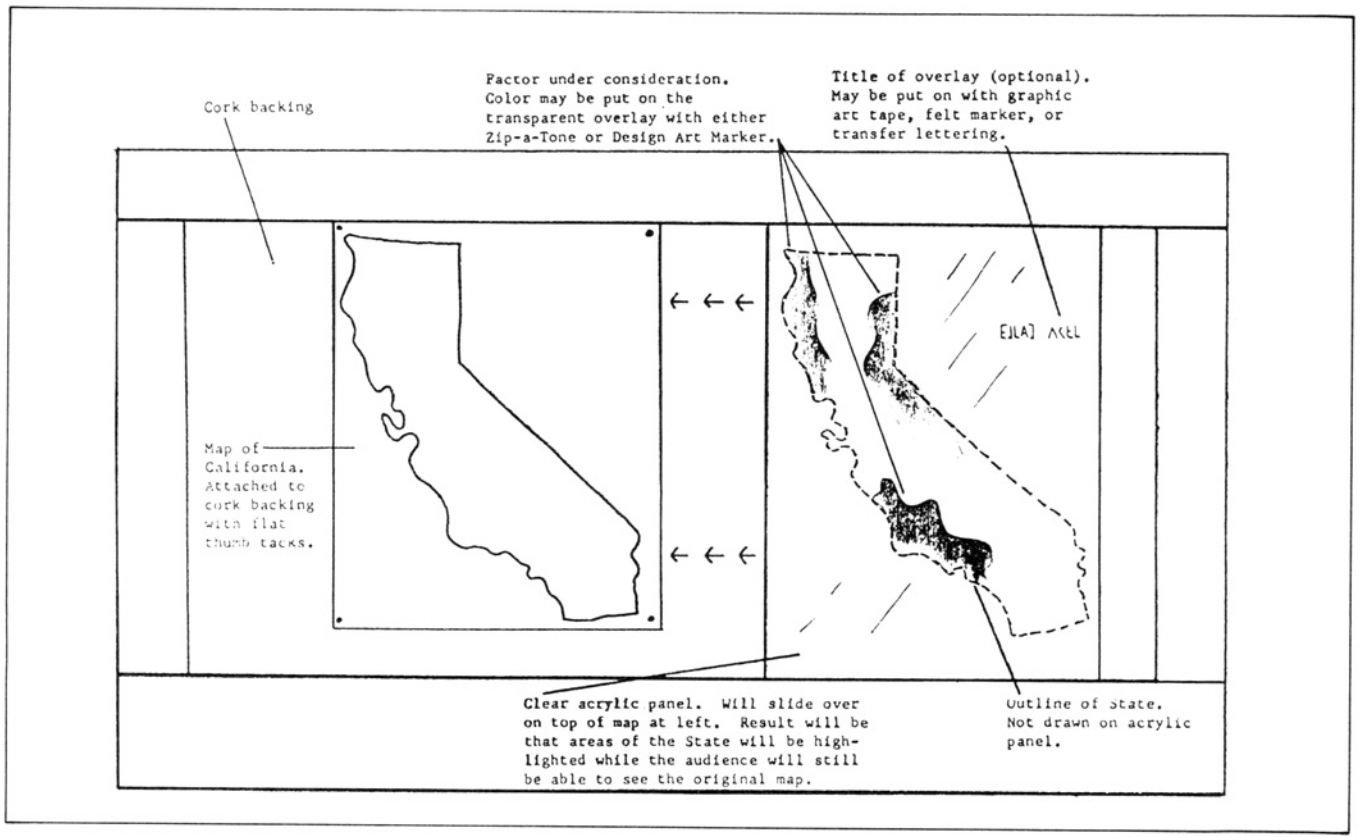


Figure 6. Front Elevation Of Visual Aids Display Case (Not Drawn To Scale).

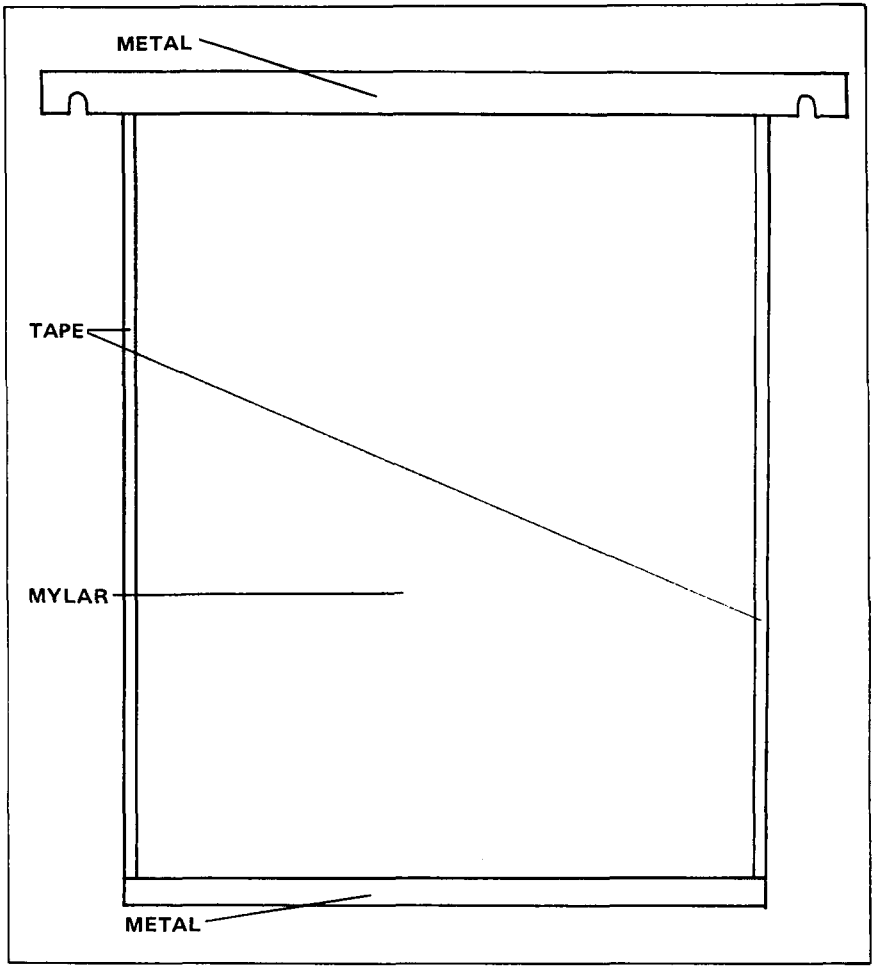


Figure 7. Transparent Mylar Overlay (Not Drawn To Scale).

Figure 3, if the areas represented by the slash marks were colored blue and the areas represented by the dots were colored yellow, areas where the two colors overlapped would be green. Similarly, if the colors blue and orange were used, a brownish color would appear where the colors overlapped. To carry the process one step further, the color green representing the factors previously shown by the overlapping of the colors blue and yellow may be placed on one overlay, while the color brown representing the overlap of the colors blue and orange can be placed on a second overlay where these two colors overlapped a dark brown color, or what could be termed the critical mass, would emerge (Table 4). The overlay process should not, however, be repeated more than three or four

Table 4. Suggested Colors for Transparent Overlay System

Blue (Factor A)	+	Orange (Factor B)	=	Brown (Overlap of Factors A & B)
Blue (Factor C)	+	Yellow (Factor D)	=	Green (Overlap of Factors C & D)
Brown (Factors A & B)	+	Green (Factors C & D)	=	Brown-Green (Overlap of Factors A, B, C, and D. Also known as the critical mass)

Table 5.

Maps	*Potential Sources*
1. Local Planning Maps a. General Plans b. Specific Plans c. Community Areas d. Zoning Maps	• City, County, Regional, and State Planning Departments and Agencies
2. Tentative (and Final) Subdivision Maps	• Developers • Engineering Firms • Local Government Planning and Engineering Departments
3. Tax Assessor's Maps	• City and County Assessors' Office
4. Highway Maps	• State Transportation Departments • Automobile Clubs
5. Topography Maps	• U.S. Geological Survey
6. River Survey Maps	• U.S. Geological Survey
7. Insurance Maps	• Insurance Companies • Sanborn Map Company, 629 Fifth Avenue, Pelham, New York 10803[a]
8. City and County Maps	• Government Public Information Offices • Local Chambers of Commerce • Commercial Map Makers (such as Thomas Brothers)
9. Engineering Survey Maps	• Local Engineering Firms • City and County Engineering Departments
10. Special District Maps	• City, County, and Regional Planning Agencies • Special Districts

[a]The Sanborn Map Company has been mapping communities throughout the United States since 1866. Their collection of city maps provide a basic inventory of building stock in a given area including building outlines, building identification, construction details, number of stories, and heights of major buildings. Originally published for use by fire insurance companies, the maps today are utilized by other types of businesses and agencies such as various municipal government departments, utility companies, financial institutions, and real estate offices. For further information the Sanborn Map Company should be consulted directly.

times, whether colors or patterned overlays are created, as the factors tend to become blurred.

There are many types of base maps applicable to urban areas that may be used with the visual aids display case. Table 5 lists several kinds of maps and possible sources. Besides these sources, local firms which specialize in maps should also be consulted.

Besides being used as base maps, the maps mentioned above can also be used to create transparent overlays. For example, special district maps of water and fire districts in a county can be used to create two transparent overlays which delineate boundaries of these districts. These transparent overlays can then be placed over a base map of that county. Other items that can be placed on the transparent overlays for use with base maps are detailed in Table 6.

Table 6. Items to Place on Transparent Overlays When Used in Conjunction With A Base Map

1. Jurisdictional Boundaries	
Fire District Boundaries	Mosquito Abatement District Boundaries
Park District Boundaries	City Limits
Water District Boundaries	County Boundaries
School District Boundaries	Community Planning Area Boundaries
Utility District Boundaries	Spheres of Influence
Cemetery District Boundaries	Council of Government Boundaries
Reclamation District Boundaries	Drainage District Boundaries
Ambulance/Paramedic Service Boundaries	Flood Control Boundaries
	Sewer Service Boundaries
2. Pinpoint Transportation Routes	
Railroads	Watercourses
Highways	Airports
Local Streets	Surface Freeways
3. Recreational Areas	
Including Lakes, Rivers, Parks, Resorts	
4. Areas Associated With Development Activity	
New Office, Industrial and Residential Construction	Areas for Sale or Otherwise Available for Development
Areas Where Development Has Taken Place Within the Last Year	Pinpoint Areas Where Demolition is Taking Place
Outline Redevelopment Areas	
5. Miscellaneous Items to Pinpoint	
Major Industrial Centers	Fire Stations
Major Employment Centers	Civic Centers
Major Commercial Centers	Educational Facilities
Toxic Waste Disposal Sites	Government Institutions and Buildings
Population Concentrations	Rent Price (high rent, low rent areas)
Noise Contour Lines from Airports	Housing Prices (high price, low price areas)
Air Quality	Income Level by Potential Growth
Geography	Migration

One can visualize the many ways in which the facility can transmit different types of information–from Federal Census Data for use in marketing analysis, economic data for industrial site location, service demand data for public works departments, etc. The key to monitoring urban areas using visual data techniques is versatility–not limiting oneself to a certain type of data. This similar technique was utilized by Ian L. McHarg in his book, *Design with Nature*. He emphasizes displaying human cooperation and biological partnership with design and nature. Mr. McHarg's emphasis when examining urban areas are that one needs to consider not only the planning issues and process but also examine other conditions imposed by nature as well. For example, Mr. McHarg developed a highway route selection process for the Richmond Parkway in New York by identifying the critical factors affecting its physical construction and identifying social values, ranking each from high to low and shading each factor. The factors listed below were considered for the study:

Slope Bedrock Geology Soil Foundation Conditions Soil Drainage Susceptibility to Erosion	Criteria employed by engineers–the degree of opportunity or limitation they afford is directly related in the cost of construction [3, p. 35].
Historic Values Water Values Forest Values Wildlife Values Scenic Values Recreation Values Residential Values Institutional Values Land Values	Evaluations of natural and social processes.

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Direct reprint requests to:

Cortus T. Koehler
California State University, Sacramento
School of Business and Public Administration
Department of Organizational Behavior and Environment 096
6000 J. Street
Sacramento, CA 95819