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## Evaluation criteria for the selection of computer mapping systems

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Significant differences exist between the computer mapping products available in today's market. The way in which data are managed and manipulated by a system, in which information is represented in the mapped end product, the resources required for use, and the level of service provided by the vendor, are all important criteria that distinguish one product from another. Ultimately, the computer-mapping system selected should satisfy the application needs and environment of an organization. However, identifying the decision-making criteria to use in the selection process can be difficult unless one is aware of features available across products, and understands how these translate into potential benefits or problems.

Computer mapping systems use data as raw material in order to present relationships in a visual, geographic form. Therefore, a mapping system designed to truly support market analysis should be capable of organizing and managing all the information required for decision-making. One of the first issues to address in selecting a mapping product then is whether a mainframe computer or microcomputer-based system is required.

Centralized organizations with large varied data files on customers, demographics, lifestyle profiles, competitive information, consumption patterns, performance, etc., should consider a mainframe based product. Mainframe based systems are designed to process large data files efficiently, execute tasks quickly, and perform more complex functions. The cost of mainframe based products are higher than micro based. However, most of these systems help organizations optimize their investment in data by bringing the information to multiple users for different applications. Mainframe computers also tend to provide more powerful analytical capabilities, increasing the utility of maps in complex problem-solving.

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Decentralized or smaller organizations may find that microcomputer based mapping systems offer some of the capabilities of mainframe packages at a lower cost. Each micro workstation is an autonomous unit in which the data base may be designed and enhanced on an individual basis. Packages that interface easily with spreadsheet or reporting programs allow users to build a data base for mapping that includes information from a variety of sources. The greatest issue related to selection of a micro based system is the limit to the amount of data that can be stored and used at one time. New laser disk storage has provided users with access to a large volume of vendor supplied data. However, these data cannot be integrated with other information so that relationships, for example, between a company's retail performance and the corresponding demographic profile of that sales area, can be viewed on the same map.

Mapping systems index data to geographic units. Products differ greatly, however, in the number of geographic types to which information may be linked and, therefore, the types of data which may be represented in maps. All mapping systems display information through areas such as census tracts or postal zones. Mapping systems that also index data to locations and networks provide users with a higher level of analytical and interpretive capability. A retail location's performance, product mix or pricing may be thematically represented at different outlets. Traffic counts, type of roadway or directional information may be shown by varied transportation networks. A system that represents information linked to two or three geographic layers in the same map allows users to evaluate performance at a retail outlet in the context of the underlying market demand, the success and spatial location of competitors, and the level of traffic flow near the facility.

The structure of a system's data base can limit the flexibility with which the information may be used. In systems with parallel or hierarchical

structures, information requests or queries must conform to the way in which data are organized in the data base. With a relational structure, any data item, be it a map element or an attribute in a related table, serves as an entry point or "front door" to the entire data base. Every attribute related to an individual geographic unit is also linked to all others. As a result, questions may be based on decision criteria or rules, in a way that replicates the human thought process.

The benefit of a relational data base structure is that it may be possible, if the software product is appropriately designed, to query the data base using multiple criteria related to the attributes of geographic areas. For example, the user may want to see only census tracts that have median home values greater than \$100,000 in which he has less than a 15% customer penetration level. A solution set of only the units meeting these criteria is formed.

These units may be further color segmented by another variable such as percentage of population between the ages of 20 and 34 years of age. Geographic units that meet a first-order set of criteria are first identified. These units may then be automatically segmented by variables that support more concrete decision-making. This type of system performs the work that multiple overlays of single variable maps ultimately achieve, but with greater efficiency and speed.

A major problem in data analysis has been the inability to integrate data that did not correspond to common units of geography. Often data important for planning are excluded because they are not comparable to other information in a common framework. This problem is solved with a computer mapping system that integrates data through its inherent common element - geography. Disparate geographic units are merged through an overlay process in the system, producing solutions to queries that are made up of the unique

geographic segments that meet all imposed criteria. Resulting geographic units may then transcend standard geography and consist of the intersections of units such as zip codes and census tracts.

Map overlay eliminates the need to continually geocode data to a consistent geographic unit. Customer information linked to zip codes may be analyzed directly with demographic information based on census tracts. In addition, if the overlay process includes two or three types of geography (areas, networks, locations), relationships between information based on disparate geographic types may be studied. For example, only retail locations with poor revenues that are also in areas with high potential demand for the products or services offered could be mapped. The time consumed in map interpretation is greatly reduced because a key problem or situation is directly identified through the query. In maps with every area and location represented, a labor intensive and often non-methodical search process must be conducted to identify relevant areas.

Often data are not stored in the form most useful for analysis. Some products feature the ability to perform mathematical operations using attribute items from the data base in any valid arithmetic expression. New data items formed may be used immediately in a query without making permanent modifications to the data base. For example, raw counts of quarterly sales performance can be changed to percent growth. Demand estimates could be developed by applying an equation such as (target population X percent expected conversion X average dollar sale).

As an aid in selecting meaningful data categories for segmentation, some systems display the distribution and range of values for each variable. Products may also automatically create categories with even counts of data, or let users select breakpoints, and automatically display the resulting histogram. Histogram

displays may represent the distribution of a variable on an individual or cumulative basis by the number of geographic units or by the size of the area in each category.

Representing raw counts or even percentages of data in maps often leads to the misinterpretation of information. Systems that perform density calculations help users understand that even though a large zip code region has a large population, that population may be much less concentrated than in a small region with a smaller number of residents. Through dot-density mapping, the concentration of data may be viewed on a macro-level.

The ability of a system to zoom-in and increase the resolution of map elements before plotting is important in applications which include the study of locations or street networks that may reside in close proximity. Retail bank branches are often located on the four corners of one intersection. Displaying all bank offices in one county would mean that many locations would be plotted on top of one another. The ability to increase the resolution should be contrasted with what many systems accomplish when they enlarge a screen display. It is the difference between blowing up a photograph, to enlarge elements, and using a zoom-lens so that greater detail is actually captured.

Managers under pressure to make fast decisions, or overloaded with work, can quickly test hypotheses in systems with on-line interactive planning capabilities. Computer screen geographic solutions are immediately produced and may be scanned for important relationships. An entire nation may be analyzed using broad criteria, then each area of interest seen in greater detail using stricter criteria on smaller geographic units. A systematic macro to micro analytic framework helps pinpoint target areas for further study in a highly efficient manner.

The extent to which maps are used to understand spatial relationships and distance will

be an important criterion in deciding whether the system required should produce cartographically accurate maps. Many micro based products today create a graphic image of map elements but do not relate these elements to a projection system or scale. Cartographically accurate mapping systems usually display longitude and latitude "tick" marks and present a scale for use in calculating exact distances between specific locations.

Mapping systems that summarize information in rings around a location, within a bank of geography, by solutions sets, or in various other shapes give insight into the specific composition of target markets. Systems that integrate information from various data sources are able to produce reports on a full spectrum of information about areas. Some reporting functions enable users to specify custom layouts, others rely on default parameters. Packages with a high degree of data manipulation and calculation capability eliminate the need to transfer data for this purpose to other software packages.

Another feature to consider in computer mapping systems is the ability to display data items in the data base near the corresponding geographic elements. These items are not necessarily part of a query, but provide additional detail about specific areas, locations, or networks. For example, the average family size and lifestyle profile label could be printed in areas that are also being color-segmented by sales performance.

Computer mapping systems differ greatly in the amount of attention that has been paid to information display on finished maps. Hatch and cross-hatch patterns are available for plotting in a variety of angles. Multiple symbols and patterns such as dashes and double lines may be used to segment locations and road networks. Text for title and legend boxes may be automatically developed by the software and displayed in a selection of font styles and

sizes anywhere surrounding the map image.

To the extent that it is possible, the colors and patterns selected for terminal displays should extend directly to map specifications so that this information does not have to be re-entered. Systems with a direct interface to off-the-screen color printers exactly replicate a screen image on paper. This method of map production is the easiest and fastest, displaying first on the computer screen exactly what will be produced in the printed map.

The degree of user friendliness may mean the difference between whether the computer mapping system becomes a successful and often used decision support tool. Products should include on-line help programs, fully prompted input screens, and English-like syntax. Familiarity with a programming language should not be required. It should be possible to save and recall for editing queries and plotting specifications. Finally, a system should be ergonomically easy to use by individuals with a wide range of functions and skill levels.

Most companies offering computer mapping packages also supply geographic files. Vendors may specialize in providing highly detailed map files that include features such as cities, parks, airports, lakes, rivers, bridges, rail and rapid transit lines as well as multi-layered transportation networks. These features add a significant level of detail that reduce or eliminate the need to use base maps for further reference.

A product which includes the capability of digitizing and encoding files will allow the user to add or modify map elements on an ongoing basis. This may be a particularly desirable feature if, for example, the market typically under study has rapidly changing elements such as retail locations, or if an organization's sales regions or other administrative units frequently change.

The ease with which the tabular data and map files in a system may be modified is important if the system is to be continually enhanced. Information such as sales performance may be a desired addition on a quarterly basis. It should also be possible to easily add additional geographic areas and units to the system, with programs linking new data to the corresponding map files. Learn whether a major reorganization of sales regions, or additions in product line, would require restructuring of the data base, and how easily this is accomplished.

Turnkey systems, which integrate software and hardware into a readily usable package, are convenient but rarely allow custom modifications that can make a system much more valuable to a specific organization. For example, a system that cannot integrate proprietary company information or data from other vendors offers limited scope.

Include, in the cost of a system, the cost of other software required for operation either on a micro or mainframe computer. Additional hardware may also be required such as graphics boards, emulator cards, terminal controller, modem, and, of course, plotters and/or printers. For mainframe products, it will be important to understand memory (region) and disk storage requirements.

Selecting a vendor who bases his success on the satisfaction of his customers is an important ingredient in selecting the right computer-mapping product. Vendors with experienced personnel in your industry or function may provide valuable application support. Vendors that market demographic data, map files and mapping software offer one-stop shopping that can reduce the time spent with several different vendors. Software maintenance programs provide enhanced versions of a product, thereby maintaining capabilities close to state of the art. And it is most important that vendors should provide training, installation, testing, tutorials, system documentation, and

toll-free telephone assistance.

Vendors confident the functionality and benefits of their product may offer test or pilot projects to enable companies to gain hands-on experience at little or no cost. Taking advantage of these programs will promote confidence that the system selected is the right one for the application needs and structure of your organization. □