Part 1: Computer Cartography's Contribution to Problem Analysis and Institutional Decision-making

PRODUCT/MARKET MATCHING SYSTEM

A computer-assisted approach to tourism planning

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INTRODUCTION

OVER THE LAST DECADE, the complexion of tourism has changed dramatically –in Canada and elsewhere. The accelerated economic growth of the sixties and early seventies spurred a boom in travel activity, characterized by random and extravagant consumption. In light of this relatively indiscriminate demand, there was little or no competition among suppliers of travel services and facilities. This rush to prosperity was interrupted by two energy crises in the seventies with growth slowing to a halt by the beginning of this decade, manifest in the recent recession.

This changing economic reality was accompanied by a shift in social values. Environmental concerns rose to the fore of social consciousness. Quality once again became a principle of consumption. Conservation has become a firm commitment rather than a temporary inconvenience. Together, these factors have produced a consuming public which is more discriminating and more conscious of value for money. Moreover, this new demand pattern is considered fundamentally different in that its impact will last and not automatically reverse with economic recovery.

For the tourism industry, the new consumption pattern has constrained the growth of demand. On the supply side, the corollary has been an expansion of competition. Quality of plant, competence of personnel, level of service, price, location, additional amenities and variety have all once again become crucial variables to the health of the tourism trade. This competition extends globally. Every country in the world has a tourism industry and for most it is an important sector. Industry health in a given country is, in many ways, a relative phenomenon.

To the Canadian economy tourism is extremely important. Representing $16.5 billion annually, tourism accounts for over 5% of national GNP. Over 100,000 businesses and more than 1 million jobs are directly associated with tourism. As this tourism income filters through the economy, a further $28 billion is generated in indirect jobs and income. Clearly, the health of the industry is a national concern. The federal government, through Tourism Canada, regards the tourism sector as a vital instrument of economic development.

THE NEED FOR A PLANNING SYSTEM

If Canada is to expand its share of the increasingly demanding tourism market, planning is key. Tourism plant takes time to put in place, necessitating planning not for the present but for the future. In contrast with the scattered and disjointed tourism facilities characteristic of the industry's past, the current concept for tourism development is destination zones. These zones are specific, but not rigidly prescribed, geographic locations of potential for tourism development based upon significant tourism factors (Gunn, 1982). Product/market matching can be used to identify these destination zones.

Fundamental to planning under the destination zone concept is the ability to identify those locations where there exists the potential for a critical mass of plant and service which addresses market demands. If a critical mass can be developed in such locations, a synergy may be effected which will, in turn, facilitate self-sustained growth towards a fully developed destination area.

To assess the potential of comparable locations and markets, crucial planning elements must be evaluated. Locational factors include environmental features, recreational potential, existing infrastructure and myriad others. Against these evaluations must be applied a layer of market factors, such as demographics, economic forecasts, leisure trends, income levels, changing tastes, education and others. Gridding these two sets of factors should reveal those destination zones suitable for tourism marketing and investment planning.

Tourism planning in Canada's public sector is done by both the provincial and territorial governments and by the federal government. The objective of this planning has been to encourage sensible economic growth of the tourism industry through marketing and incentives to private tourism investment. Into this planning process must now be integrated the concept of destination zones. However, without sufficient regard for optimizing development in a national or regional context, the relatively independent efforts of different levels of government can result in a series of competing opportunities. The challenge is to develop a practical planning system which will not only identify potential destination zones, but which will facilitate better tourism marketing and development decisions leading to coordinated and balanced growth of the tourism industry in Canada.

THE RESPONSE

Tourism Canada, the federal government agency responsible for tourism development and marketing, has taken up this challenge. For several years, Tourism Canada has been moving towards a product/market match capability. Since the early 1970s, Tourism Canada has been steadily creating several major data bases and a new planning system which will facilitate coordinated tourism development. A major step has been the creation of a national inventory data base (under development since 1980) which is a key source of information on Canadian events, attractions and accommodation facilities. To complement this product information, Tourism Canada has conducted numerous market research studies in Canada, the U.S. and several overseas countries which provide useful insights into attitudes, perceptions and preferences of specific market segments.

This information serves as an invaluable tool by which comprehensive and rational proposals for tourism development initiatives can be developed, especially when a national or regional perspective is required. The product/market matching system now under development is a major integrative component of the planning process.

A search of technological literature revealed that while many computerized systems exist, none is specifically configured for tourism planning. A systematic approach to this process was required. Tourism Canada contracted DPA Consulting Ltd. of Ottawa to undertake a four phase process to design and develop a system suitable to these planning needs.

In terms of technology, Tourism Canada's product/market matching system will be a first for Canada's tourism industry and puts Canada in the forefront of high technology applications to tourism planning.

THE PRODUCT/MARKET MATCH CONCEPT

The product/market matching model is not a new one. Other industries and government bodies apply variants of the model in specific contexts. Conceptually, product/market matching is very simple: to match market requirements with product attributes.

At Tourism Canada, 'matching' is defined as a two step process aimed at achieving 'macro' and 'micro' analytical goals. Macro analysis involves the identification of opportunities. For example, given the attributes of a tourist market segment, those locations in Canada (or a region of Canada) can be identified which most closely match the known or perceived needs. Similarly, given the attributes of the tourism product, those market segments most likely to be attracted to the destination can be identified. Alternatively, and key to tourism planning, market segments and loctional data can be correlated to identify those improvements which are required to make the location attractive to the segment. At a broader level, tourism attributes of other countries can be evaluated against market preferences to assess Canada's competitive position.

Micro analysis is the subsequent detailed financial and economic assessment of specific development opportunities or plans in a particular location. For example, how the tourist market will be shared among competing facilities, the projected financial performance of a proposed tourism project or development plan, the estimated impacts (direct, indirect or induced) and net economic performance of a proposed project.

The system being developed for Tourism Canada provides the capacity to simultaneously consider the many spatial attributes representing tourist activities or plant descriptors. Moreover, computerizing this process will provide the flexibility required to respond to ever-changing product and market factors.

By level of analysis, the macro analytical process will be phased into operation first. This is a relatively new process in the tourism industry. The macro analysis will use a series of maps representing different aspects of the tourism product in conjunction with market preference criteria to identify, via an overlay process, the location of the product/market match. This spatial representation is a critical dimension of the destination zone concept of tourism planning.

SYSTEM OVERVIEW

The hardware configuration for the product/market match system includes a Spectrix micro-computer with an M6800 micro-processor, a 30 megabyte hard disk, a Matrox GXB 1000 colour graphics board and peripherals for input and output. Major software components include a Quadtree structure approach to store map data and a Graphics System which incorporates the major processes of the product/market match system.

User Interface

The product/market match system is completely driven by a set of menus which are displayed on the terminal screen in a sequence controlled by the user. The menus are designed to aid the user in generating the various available reports (at the macro or micro level) and the desired map overlays (applicable to macro analysis only). At any point in the system, numerous 'help' screens are available upon request to supply additional details relevant to the current display. Also accessible at any point are inquiry screens concerning colour codes (a list of colours with their corresponding codes is displayed), map keys (a list of map keys in hierarchical order, alphabetical order or by category as specified by the user is displayed) and map IDs (a list of map codes and corresponding map titles that contain all map keys specified by the user is displayed).

Quadtrees

In order to store maps into memory, an image representation with minimal storage requirements is necessary. The quadtree is extremely efficient in that it deals with entire regions instead of single pixels (coloured points on the screen). The quadtree is physically similar to a binary tree in that a node, 'the father', is subdivided into more nodes and so forth. The only major difference is that the father node of a quadtree is subdivided into four nodes as opposed to two for the binary tree. Figure 1 schematically describes the conversion of an image to the corresponding quadtree. In order to create the quadtree, a square image is subdivided into four equal quadrants. If a quadrant consists entirely of one attribute (or colour), then the corresponding node becomes a leaf and is assigned a colour code. As Figure 1 illustrates, nodes 2, 3, 1.1, 1.2, 1.4, 4.1, 4.2, etc. are all leaves that would contain the colour code of the area which they represent. If by examination it is determined that a quadrant does not contain a unique attribute (or colour), then the quadrant is further subdivided into four more quadrants and the process of examination is repeated.

Notation for a quadtree is as follows:

1 The root of a quadtree is the node from which all the nodes expand. The root is unique in a quadtree;

2 A leaf is a node with the characteristic that it has no sons, thus it is not further subdivided. A leaf is often referred to as a terminal node;

3 All other components of the tree are simply called nodes.

If an image has large quantities of small areas and points of different colours, such as maps, then a simple matrix representation of each point of the image can require considerable amounts of memory space. Consider a colour screen con-

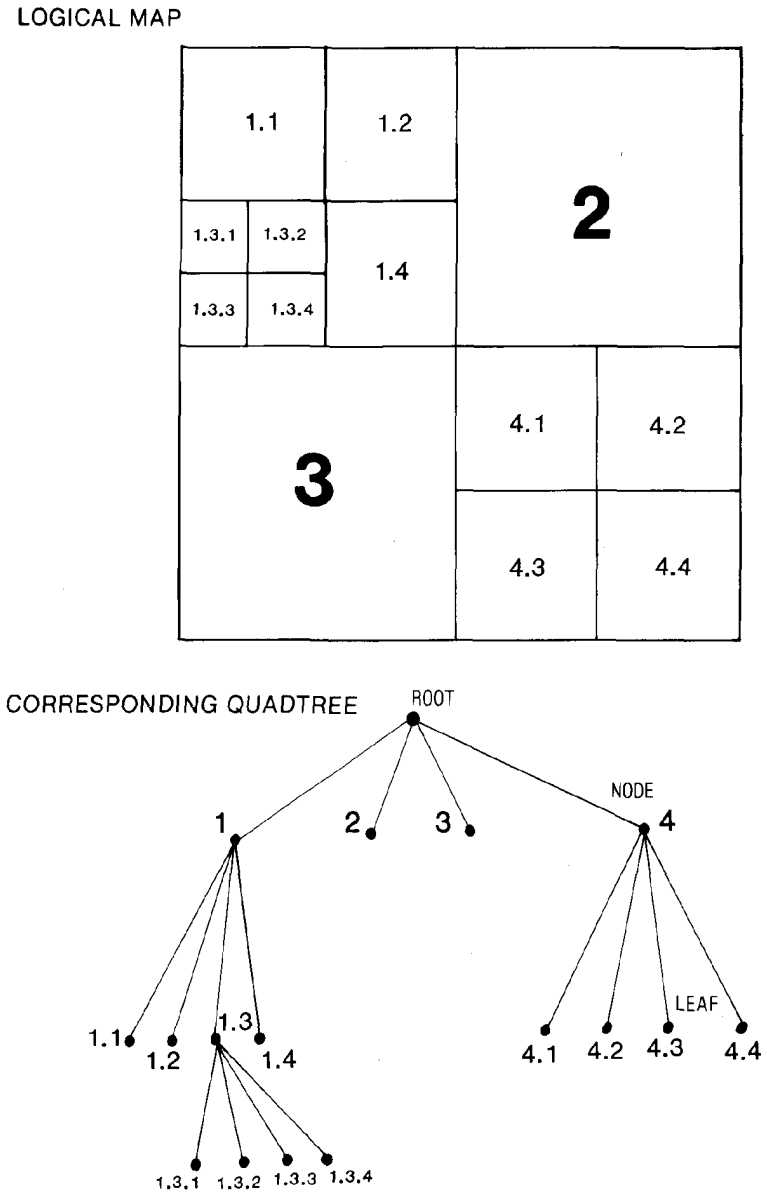

FIGURE 1. *Schematic description of quadtree.*

sisting of 1024 × 1024 pixels (coloured points), then it is realistic to assume that a matrix representing this image could occupy in the order of 1 Megabyte of memory. That is obviously unacceptable since most micro-computers cannot address more than 1 Megabyte of memory, and the overlay process deals with three images simultaneously: the two original maps and the resulting map. The

selection of the quadtree image representation is of significant importance for the storage and image processing efficiency of the graphics system. While the specific storage and processing time efficiency will vary depending on the complexity of the images being represented, analysis suggests that on average the quadtree approach will reduce storage and processing time by a factor of 10 over the pixel by pixel method.

The first major discussion of the use of quadtrees explained the idea of the quadtree and proved the advantages of such a storage method mathematically (Hunter, 1978). Further developments were made expanding the concept of the quadtree into codable algorithms (Samet, 1981). However, most of the existing literature considers black and white as the only possible colours in an image. For the Tourism Canada system an enhancement was required to this methodology to distinguish between as many as 256 colours, each colour representing a different combination of intensity of blue, green and red.

Input/Output

Figure 2 represents the product/market match computer system. The major input to the system comprises a variety of maps of Canada and its regions. Each map represents either an attribute, such as weather conditions, accommodation, distance from airport, etc. or a breakdown of Canada into counties, census divisions or other meaningful sub-regional zones. Base maps can be created through a manual digitizing process or they can be created automatically from Tourism Canada's inventory data base which is geocoded. The following information is associated with all maps:

1 A map identification number for retrieval purposes;
2 A map title;
3 A set of up to five map keys (key words to describe the map), again for retrieval purposes;
4 A legend describing the sections of the map;
5 A colour scheme, where each legend item corresponds to a different colour.

Three devices are used as principal output media. Firstly, a terminal where the interaction between the system and the user takes place. Secondly, the colour monitor where maps or reports can be displayed. Finally, the colour printer where hardcopy maps are reproduced according to the user's request.

Process Description

Figure 3 illustrates the system data flow. The Graphics System contains seven main processes described as follows:

P1. Map Management System. This system is an interactive process used to retrieve and store tree representation maps in the Map Library, and to store or update information on the maps in the Map Library Dictionary. The process also includes the creation of rasters used by the display process.

P2. Window Definition. In general, the entire map of Canada is not required for analysis. In this case a 'window' can be defined; that is, a rectangular subdivision of the original map or a predefined zone (e.g., a tourism zone – Cape

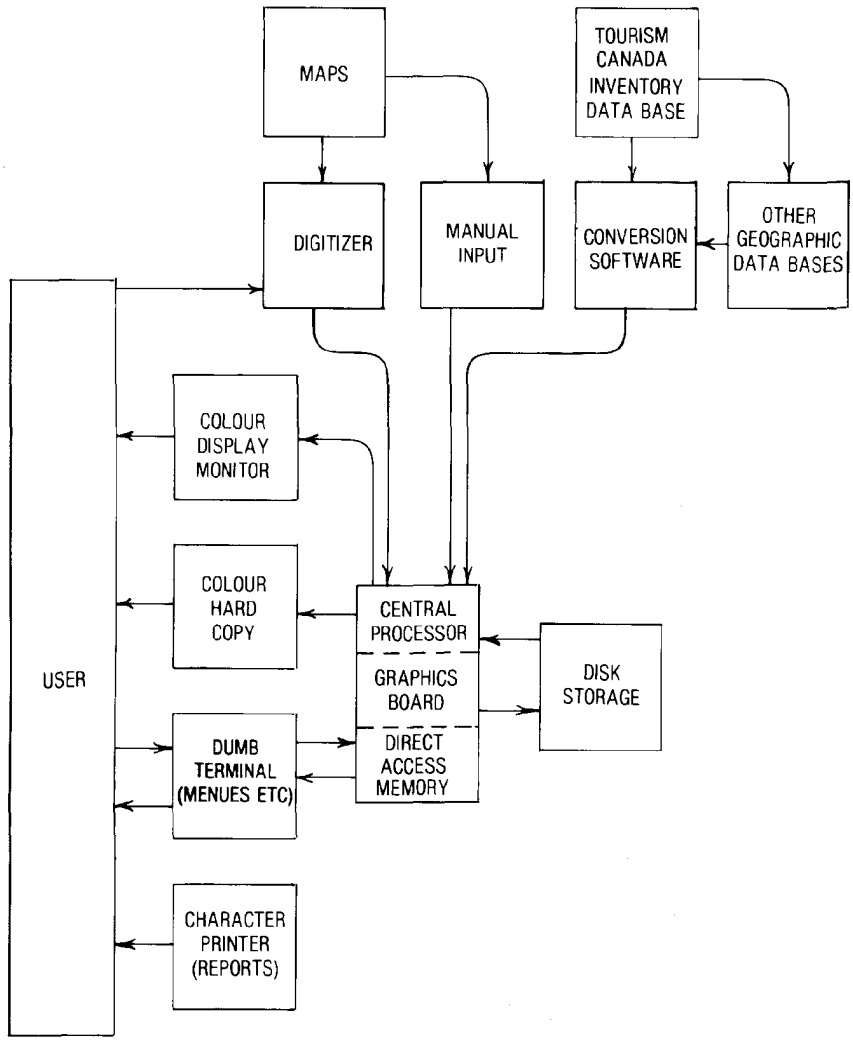

FIGURE 2. *Tourism Canada's computer system diagram.*

Breton). Only the area covered by the window will be affected by subsequent map manipulations and considered in analysis until a new window is defined. The size of the window can be increased, but cannot exceed the boundaries of the map of Canada, or decreased to cover only a few square kilometres.

P3. Overlay Process. The overlay process is the basic tool for macro-analysis in the product/market match system. When an overlay is requested (only two maps can be overlaid at a time), a default legend for the resulting map is displayd and may be modified if desired. A standard overlay matrix is generated and it may also be changed. (The entries in this matrix represent the legend items in the two

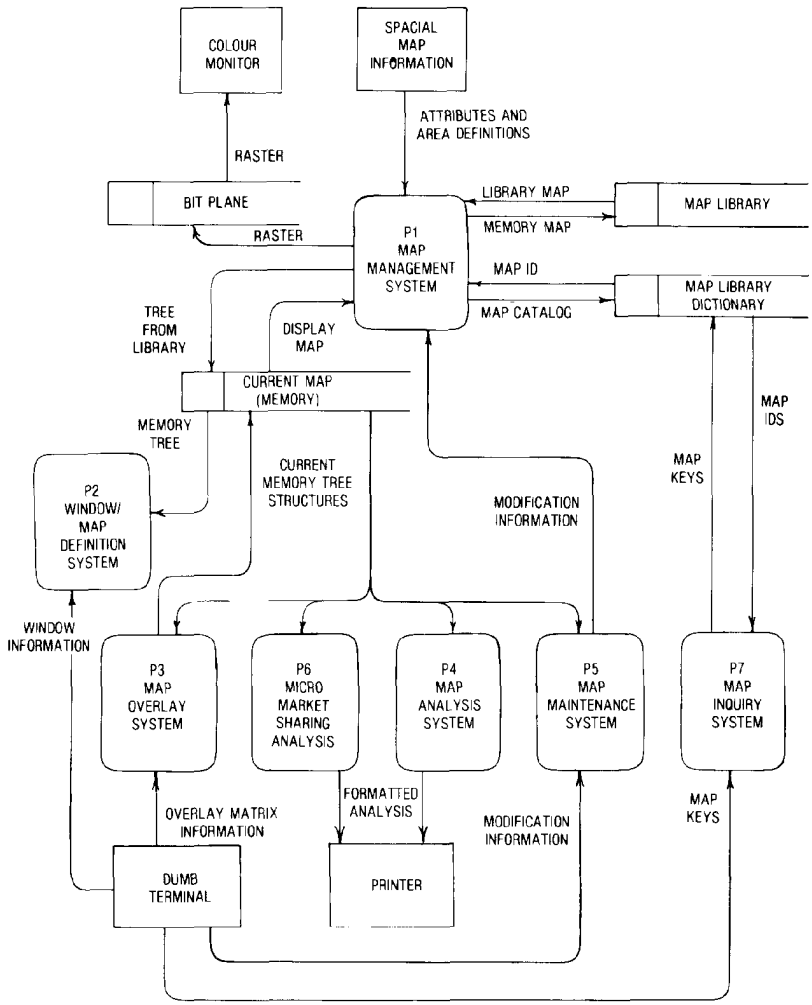

FIGURE 3. *Data flow diagram of the graphics system.*

original maps.) After the overlay is made, the resulting map may be stored in the Map Library or discarded.

P4. Map Analysis System. This process will perform an analysis of a single map or will perform multiple map correlation analysis. The process will use maps as input and will generate a series of formatted reports to be output on a printer or other device. These reports are made at the macro level.

P5. Map Maintenance System. This process will perform certain maintenance tasks on the map that is currently displayed. This process is interactive, using the current map as input along with modification parameters specified by the user and modifying and updating the map and the map representation structure with the appropriate changes.

P6. Micro Market Sharing System. This process will evaluate the suitability of a particular market segment within each zone and estimate the zone's market share, i.e., number of visitors. The general purpose of this process is to estimate the impact of the increase of resources in a particular zone (e.g., a new hotel) on the market share.

P7. Inquiry System. At the user's request, this process will assist the user by displaying map IDs and titles, map cataloguing key (used to identify a map with characteristics), and colour codes.

BREADTH OF SYSTEM APPLICATION

Originally conceived as a planning tool for tourism product development, system capability could eventually extend to many applications. Once development opportunities are identified through macro analytical map overlays, micro analytical processes can be applied to evaluate competing options. For tourism marketing, the ability to correlate product attributes and market preferences will permit more targetted and selective marketing campaigns. As a continuing, operational application, the product/market match system will be a tremendous asset to Tourism Canada's toll free 'hot line' through which travel counsellors provide information to thousands of travellers in Canada annually.

Once refined and tested by Tourism Canada, the system may be made accessible to multiple clients within government and to private sector tourism investors and developers. Eventually, if certain constraints are overcome (outlined below), direct access may be available to tourism consumers. This latter application could involve the installation of compatible hardware and transmittal software in the domestic and international offices of Canadian government departments. Prospective visitors can then access the product/market match system directly for detailed information with which to plan their trips. Other on-site installations under consideration may be international conventions and exhibitions, enabling visitors to access the system and thereby encouraging them to extend their stay in Canada. In interaction with consumers, the system will have data capture capacity allowing all consumer inputs to be stored in memory, thereby providing a large base of actual data for further research and analysis.

APPLICATION CONCERNS

Two primary areas of concern have been identified to date regarding the product/market match system. The first is a very fundamental concern regarding the ability to 'match' product and market information as they are presently in the data bases. For example, product information is often defined in terms of 'hard' or physical attributes (e.g., location, type of amenities, capacity, etc.), while market preferences are often defined in 'softer' terms (e.g., visitors wanting a 'hospitable', 'exciting', 'quality' holiday). The level of matching will be relatively restricted in the early phases of system use until product and market information can be defined in more comparable terms (apples and apples) or until an appropriate indexing system can be devised.

The second area of concern regards future direct access to the system by consumers. The hardware at the receiving computer terminal must be capable of

quickly generating hardcopy maps of high quality, that is, in multiple colours with sharp definition. Ensuring the availability of hardware with this capacity for speed and quality involves considerable expense. Another concern is associated with using one software package for transmitting data to the variety of hardware configurations throughout Canada and the rest of the world. Direct consumer access will be restricted until these system component issues are resolved.

CONCLUSIONS

The product/market match system promises to be a great advance in tourism planning techniques. The system can move from aggregate analysis of Canada as a whole to site-specific analysis of very discrete areas. The particular cartographic techniques employed in this system have substantially enhanced the ability of Tourism Canada to efficiently and comprehensively assess tourism opportunities and thereby help the federal government contribute to the more rational economic development of a vital industrial sector.

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