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Competing in Space: The Strategic Roles of Geographic Information Systems

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Introduction

Many firms today operate in global markets in which performance in one market is affected by performance in another (e.g., Ghoshal, 1987; Porter, 1990; Stalk & Hout, 1990). Information technology (IT) has been proposed as an important tool for achieving competitive advantage, including in these global markets (e.g., Clemons & Row, 1991; Keen, 1986; Kettinger, et al. 1994).

Geographic Information Systems (GIS) have appeared in business in the last decade. While growing at a rate of 20-30% per year (Daratech, 1995), some observers argue that GIS is under-exploited by business for competitive advantage (e.g., Castle, 1993a). Can GIS contribute to competitive advantage? In this paper, Ghoshal's (1987) framework for global strategy is used to explore how GIS technologies may contribute to strategic choices and therefore to competitive advantage.

GIS as used in this paper refers to the computer-supported application of spatial representation and analysis to business phenomena such as retail sites, customer addresses, distribution centers, and networks.

Strategy and Information Technologies

Global Strategy Framework

Ghoshal's (1987) framework for global strategy organizes several streams of multi- and trans-national strategy research and helps clarify the "inherent contradictions between the different sources of strategic objectives and the different sources of competitive advantage" (p. 437). Three organizational goals are efficiency in current activities, managing risks, and developing internal learning, innovating and adapting capabilities. Three strategic tools represent classical sources of competitive advantage: economies of scale, economies of scope, and regional or national differences in costs of the factors of production. His framework can be used to assess the issues and factors that any one operationalized strategy would generate.

Competitive Advantage from Information Technology

Sources of competitive advantage from IT have been advanced by different authors include (Clemons & Row, 1991; Johnson & Vitale, 1988; Keen, 1986; Kettinger et al. 1994; Porter & Millar, 1985). Some of the mechanisms identified have included:

- easier access to markets;
- increased bargaining power;
- changing products through differentiation;
- providing cost efficiencies;
- changing an industry's structure or competitive form.

Clemons and Row (1991) look to Resource Dependency Theory and Transaction Cost Economics to identify sustainable sources of competitive advantage for IT. In a similar study about IT sustainability, Kettinger et al. (1994) proposed three sets of factors: environmental, foundation, and action strategies.

In contrast to these strategic IT studies, Ghoshal's framework operates at a more abstract level. Applications generated by early adopters of GIS in response to their own environment and problems may tell us much about the potential for gaining competitive advantage with GIS. Business GIS technologies, while more aggressively adopted in the United States, have the potential to alter both domestic and international markets and competition. A caveat to the reader is in order based on the sources of these reports: most are taken from self-reports or industry trade publications and are not independently verified for the nature of the project or its effect. The objective is to identify applications not be familiar to most strategists.

GIS and Strategic Goals

The following discussion of strategic goals and GIS shows how GIS technologies can contribute to a firm's effort toward a strategic objective. Table 1 contains a summary of key applications for GIS and strategic goals.

Efficiency in Current Activities

Maximizing efficiency of the resources of the firm has been a classic area of competitive advantage (e.g., Porter, 1980). This is 'doing what you already do, better' (Ghoshal, 1987). An example of achieving efficiency in current activities is seeking large production volumes to achieve learning curve gains (Stalk & Hout, 1990).

De Man (1988) argues that the information needed by managers for decision making (tactical and strategic) has significant spatial aspects. Because "means are employed somewhere" (p. 246), he proposes that GIS shines through better management of "means". For example, when the means are moving or moveable assets such as vehicles, GIS can be used to either keep closer track of actual location and status or to plan for more efficient deployment of those assets across space (e.g., Kolli, Damodara, & Evans, 1993). Conrail (Betak, 1994) has been able to increase the efficiency of the trains in their system by having more accurate information about their actual locations. Wells Fargo improved transaction processing by more efficiently allocating processing within its network using GIS (Wendelken, 1995).

Other examples of 'doing what you do, better' are Val-Pak Direct Marketing Systems' (Wendelken, 1994) and Harte-Hanks Communications' (Bernauer, 1995) who use GIS to help customers do micro target marketing. Sears' Homart division (Castle, 1993b) and OfficeMax (Business Geographics, 1994) report using GIS to identify retail locations -- a critical success factor -- with more success.

Managing Risks

Managing risks means increasing the probability that the efforts undertaken will produce rewards (Ghoshal, 1987). Kettinger et al. (1994) identify managing risk as an "action strategy" available to management in their strategic use of IT. Types of risks include macro-economic, political, policy, and regulatory, competitive, and resource and physical/ environmental risks such as hurricanes, earthquakes, or other disasters.

There is little evidence that GIS applications have been harnessed for macro-economic risk management, but several cases show its usefulness for political, policy, and regulatory risk management. For example, GIS has been used to identify potential loan red-lining (Battista, 1993), to manage environmental compliance and engineering (Douglas, 1995) and to study the potential effects of health care reform (Davenhall, 1994).

Crisis management may be helped with GIS, for example USAA is using GIS to help improve service delivery during catastrophes (Lang, 1995). Also insurers can use GIS to simulate complex phenomena such as hurricanes and evaluate risk in advance of a catastrophe.

Learning, Innovating, & Adapting

Learning, innovating and adapting (LIA) capabilities prepare the organization for its future challenges -- learning how to do something new or creating responsiveness in the organization (Ghoshal, 1987)

GIS is being researched for its ability to support organizational memory and learning through use as a group decision support system (e.g., Nyerges & Jankowski, 1995). The visual power of maps suggests its potential to communicate complex situations -- as are often encountered in global strategy development. Further, maps rely less on text than some other modes of communication, GIS may enhance communication across language barriers. GIS may increase the ability of the firm to sense threats and opportunities in the environment, e.g., data mining approaches to explore trends that have a spatial component (Fotheringham & Charlton, 1994). GIS's ability to support information sharing and communication can be seen in the cases of Intranets that use geography as a paradigm and spatial technologies as a tool to organize large volumes of information and dissimilar data.

GIS and Strategic Tools

GIS technologies' role in affecting change with Ghoshal's (1987) three strategic tools is some what more difficult to demonstrate. GIS, like other IT, does not itself create capabilities, but requires informed users and enlightened application. Table 2 summarizes the potential roles of GIS as strategic tools.

Economies of Scale

Improvements in economies of scale are perhaps the most common way to achieve competitive advantage (e.g., Ghoshal, 1987; Porter, 1980; Stalk & Hout, 1990). Techniques of spatial analysis may contribute to achieving economies of scale when location is a significant factor in either production or distribution costs. This is not a new problem, as the familiar dilemma of centralization versus decentralization illustrates. When is it worth the extra cost of distribution to achieve greater economies of scale? GIS can help with the historically wicked trade-off analyses between efforts to reduce the point at which economies of scale are achievable or to reduce the costs of distribution to a geographically-constrained market.

GIS enables yet another approach: conceiving of geography not as a constraint, but as a variable to be manipulated and managed. This is a somewhat subtle issue. A good starting place for identifying situations where GIS technologies may contribute is to ask:

- When can distribution be value added to some customers?
- When can distribution improvements confer competitive advantage?

GIS can help with the first question by facilitating geo-demographic analysis that explicitly considers geography in identifying market segments (Curry, 1993). Service improvements such as faster delivery or hotter pizza can confer competitive advantage, along with efficiencies that can be used to improve customer service (e.g., shorter wait times for appliance deliveries).

Economies of Scope

Good examples of achievements in economies of scope with GIS technologies and spatial analysis are not easy to come by. Exploiting existing delivery channels for a broader product line and sharing resources across products or markets may be aided by GIS decision support.

Spatial analyses can show us where similar products have similar demand patterns. GIS can facilitate more direct modeling of consumer behavior based on spatial patterns (e.g., Castle, 1993). Achieving efficiencies in the use or joint allocation of resources that together have inconsistent or differing spatial patterns may

include planning an advertising program that involves balancing choices among broadcast, narrowcast, and targeted media.

Exploiting Factor Differences

In global markets, firms seek and exploit differences in the cost of inputs to their production functions (e.g., Porter, 1980). GIS can help in managing the large volume of information encountered when identifying and evaluating potential factor costs differences. Its visualization power reduce the cognitive complexity of these types of analyses and helps to capture spatial data and variables. GIS can also quickly identify anomalous cases where the expected spatial-cost relationship do not hold; such situations may hold hidden competitive advantage.

References available upon request from author.

Table 1. GIS and Strategic Goals

Source	Example
Efficiency in Current Operations	
Moveable asset management/re-allocable resources	Conrail; Wells Fargo
Product or service improvements	Val-Pak; Harte Hanks; Realtor's Information Network (RIN)
Fixed Asset Siting	Homart; OfficeMax
Business Management	Data warehousing with SDE
Managing Risks	
Macro-economic risk	?
Political, regulatory, policy risk	Bank loan redlining; Health care reform; Environmental management
Competitive risk	Analyze potential competitor moves such as buy-outs of retail locations
Resource risk	USAA Service planning
Physical/environmental risk	Catastrophe modeling such as hurricanes
Learning, Innovating, & Adapting	
Organizational memory and learning	Using GIS with GDSS; Using maps to reduce information overload in EIS
Early warning about threats and opportunities	Remote sensing of pollution; Data mining to explore trends; Spatial modeling of disasters
Ability to share competencies	Using maps to reduce language barriers and information overload

Table 2. Geographic information technologies and Ghoshal's strategic tools.

OPPORTUNITY	USE GIS TO:
Economies of Scale	
<i>Traditional: Geography as a constraint to be minimized</i>	
Concentrate production with increasing costs of distribution to larger markets vs. decentralize production with decreased distribution costs	<ul style="list-style-type: none"> • Better measure distribution factors • Evaluate a larger number of alternatives
Reduce cost of distribution to an existing market for reduced total costs; Increase market area served for same cost	<ul style="list-style-type: none"> • Improve routing and network analysis • Analyze service location decisions for minimum distance/cost
<i>New: Geography as a management variable for service and value-added to customer</i>	
When distribution can be value-added to some customers	<ul style="list-style-type: none"> • Geo-demographic market analysis that explicitly considers

	geography in identifying market segments
When distribution improvements confer competitive advantage	<ul style="list-style-type: none"> • Identify service improvements such as shorter delivery commitments (e.g., faster delivery or hotter pizza) • Identify efficiencies that can be used to improve customer service such as shorter wait times for appliance deliveries.
Economies of Scope	
Product or service line extensions	<ul style="list-style-type: none"> • Product based analysis to identify new products based on spatial consumption variables
Shared or joint allocation of resources	<ul style="list-style-type: none"> • Analyze resources with complementary spatial and distribution patterns that could share distribution resources (e.g., telephone network and computer network)
Rapid product change and customization	<ul style="list-style-type: none"> • Improve early detection of trends through spatial data warehousing
Exploiting Factor Differences	
Seek differences in factor costs	<ul style="list-style-type: none"> • Obtain more accurate measures of the geographic component of factor costs • Discover factor cost differences through analysis of multiple variable on a common spatial model
Exploit differences in factor costs	<ul style="list-style-type: none"> • Visualize complex information and generate ideas for exploitation • Monitor effectiveness of plans