CONSIDERING TRANSPORTATION AS A FACTOR IN FACILITY LOCATION DECISIONS FOR MULTINATIONAL CORPORATIONS

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ABSTRACT

This paper defines the role of transportation factors in facility location decisions for a multinational corporation (MNC). The factors which are generally considered for facility location decisions are described and organized into a new framework. Also additional transportation related factors are proposed. Two networks are analyzed in the process: the MNC supply chain network and the Global Transportation Network (GTN). Interdependencies among these two networks are defined. A structural interdependency should be the most attractive framework because it can lead to a competitive advantage that allows the MNC to better adapt to variability and uncertainties in the environment.

Keywords: Multinational Corporation, Global Transportation Network, Supply Chain, Facility Location.

INTRODUCTION

Industries must consider different factors when locating a new facility. What defines the “correct place”, however, might not be the same for every type of industry. Some industries have unique location needs, whereas others have greater capabilities to adapt to existing conditions. The important question is which factors should be given priority when a Multinational Corporation (MNC) is faced with a facility location decision. A different perspective to this situation is proposed here, which gives greater weight to factors associated with transportation and the infrastructure associated with the Global Transportation Network (GTN). Considering this, two elements are being analyzed within a system: the MNC’s supply chain network and the Global Transportation Network. Also, concepts related to different supply chain network configurations are identified, analyzed, and related to facility location decision models.

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LITERATURE REVIEW

Two aspects of facility location are introduced in this section: first, interdependence configurations between supply chain networks and the global transportation network as presented by Hamilton (2006) and second, common facility location factors that have been presented by various researchers.

Supply Chain Network Configurations

Hamilton (2006) identified three types of integration configurations for supply chain networks and the GTN: Transactional, Functional, and Structural, which can be related to the factors that influence facility location decisions. The differences among these configurations are based on the types of relationships or interdependencies exhibited between entities and their environment or to other networks within a system. A transactional configuration refers to an economic relationship between the networks that relates to boundary spanning activities of specific inputs and outputs. As an example of this network configuration, each MNC department would have direct communication with transportation carriers when services are required. In this way, individual transactions would be locally optimized, with regard to cost, service, delivery times, or other priorities of a single entity in that department.

A functional configuration involves relationships within and across networks that facilitate the efficient operation of a specific supply chain. Such configuration suggests that configuration changes among several entities within and between networks will result in changes in the network as a whole. For example, a MNC with this configuration would have a designated department that coordinates all of the shipping activities for the organization and interacts directly with the transportation carrier company on behalf of all entities. Thus, more globally optimal decisions can be identified for the MNC.

A structural integration configuration considers the environment surrounding a specific network, which includes the relationships across other networks that mutually influence network designs. When considering a structural configuration, the reciprocal interdependence between networks indicates that internal or external changes made to one network will necessitate changes to the other network. In this configuration, it is desirable to integrate the MNC’s supply chains with the GTN and to find possible ways for altering the design of one or the other so that they can overlap more. These two networks are more likely to be structurally aligned when there is a reciprocal relationship between them.

Previous facility location models consider only transactional or functional network configurations, which leaves less ability for the system to adapt to environmental variability and uncertainty. Related to network configurations, the objective of this document is to suggest a facility location analysis approach that is capable of incorporating the structural network configuration. The lack of adaptability in previous models has led to a new perspective for organizing facility location factors and incorporating them into a model which will address the structural supply chain network configuration.

Factors

In order to identify the factors which influence the facility location decision, three different sources are utilized: 1) “International Facility Acquisition and Location Analysis” by M. J. Schniederjans (1999); 2) “Supply Chain Management: Strategy, Planning, and Operation” by S. Chopra and P. Meindl (2004); and 3) “Operations Management: An Integrated Approach” by R. Dan Reid and N. R. Sanders (2005). From Schniederjans’s (1999) book, classification is achieved by categorizing factors into Functional areas, such as economics, politics, and so forth. From Chopra and Meindl (2004), the classification is based on a framework with four phases: 1) Supply Chain Strategy, 2) Regional Facility Configuration, 3) Desirable Sites, and 4) Location Choices. And finally, from Reid and Sanders (2005), the classification progresses from a general global perspective to a narrower specific location perspective.

Prasad and Sounderpandian (2003) propose an analysis which explains the factors that influence the performance of a global supply chain within a multinational corporation, where the factors are divided in three categories: Country, Industry and Multinational Corporation Strategy. The factors are shown to
influence the Procurement, Processing and Distribution processes which also represent the competitive advantage reflected in cost, quality, lead time and innovation. Among the third category of Multinational Corporation Strategy, there is a specific section for Transportation issues. By transportation, Prasad and Sounderpandian (2003) mean cost, accessibility, shipping patterns, on time performance, service and warehouse locations, routing constraints, inter-company traffic, types of transportation modes and carrier qualifications.

Another approach to facility location factor classification occurs when they can be naturally separated as either quantitative or qualitative factors. Quantitative factors of distance, costs, demand, capacity and times are easy to measure using units such as miles, dollars, units or hours. However, there are many others which are more qualitative in nature but should also be considered, such as: availability of housing, climate, community activities and attitudes, education, health services, recreation, religion, union activities, transportation mode, and so on.

**FACILITY LOCATION DECISIONS**

Globalization allows supply chain activities to be located almost anywhere. Barriers between countries that previously limited trade are quickly being eliminated. These conditions facilitate the worldwide expansion of the supply chain activities of MNCs and make location decisions more complex.

**Classification of Factors**

When a facility location decision is considered, it is essential to know the needs and nature of the organization which facilitates the selection and prioritization of the applicable factors by the decision maker. It can be helpful if the process is divided in different phases. Facility location decisions involve factors at global, regional, and local levels. When deciding on a facility location, the organization can start from a global perspective. Looking for the most convenient region is the first step, where regions might be defined by continents or even cultures. The second step would be to choose the country where the facility will be located. Afterwards, state, city and eventually the specific site are chosen successively.

In his book “Competitive Advantage of Nations” (1990), Michael Porter created the Diamond model which describes the competitive position of a nation within a global environment. This model presents four interlinked factors which are influenced by the Government: 1) Firm Strategy, Structure and Rivalry, 2) Demand Conditions, 3) Related Supporting Industries and 4) Factor Conditions. The Government acts as a channel to encourage organizations to raise their goals and advance their competitive performance.

Figure 1 has arrows for each dimension of Porter’s Diamond model, and relates them to facility location factors in concentric circles. The circles are intended to show the different perspective levels which classify the factors starting from the outside with a global perspective and narrowing to the local site. Thus, Figure 1 helps to simultaneously classify previously defined location factors from the literature according to two different points of view: Porter’s theory and perspective level.

In starting with the different perspective levels, it is first necessary to select the global region and country, and to consider the associated factors at that level. Competitor proximity is found in the global outer circle and it is a controversial factor that could be interpreted in several ways depending on the industry type and level of maturity. An organization would like to be located close to its competitors when the co-location of multiple firms benefits all of them, synergistically increasing the overall demand. On the other hand, being more isolated may be preferred for capturing the largest possible share of the market without direct competition. Technology, still in the global level, should be considered because it enables flexibility for adapting to diverse situations or environments. This can be necessary when day to day variability exists, for instance with regard to demand or equipment reliability and breakdowns. On a broader level, uncertainty regarding future events exists, such as introductions of new products, world politics, or new transportation infrastructure in developing countries.

Factors describing the environment are essential in the early phases of a location decision. Political, economic, socio-cultural, infrastructure, and quality factors should all be analyzed. Within political
factors, the MNC is concerned with investigating rules of commerce and legal systems, assuring government support and stability, and looking for favorable import and export regulations. As far as infrastructure is concerned, the availability of labor and sites, proximity and quality of transportation terminals, availability of rail services, proximity to airports and seaports, convenience of highway access and congestion, and reliability of local utilities are considered at this point. It is crucial to point out that the transportation concept is contained in the infrastructure aspect, but does not have the weight of being a specific and independent factor. Socio-cultural criteria affect quality of life in selected locations, including aspects such as the language learning curves, cultural compatibility, management training costs in a specific country, and availability of recreation areas, religion, insurance companies, or health services.

FIGURE 1 Facility location decision factors classified using Porter’s Diamond Model

The economic criterion is one of the most important factors that needs to be considered at regional and state or country perspective levels in multiple contexts. Currently, many organizations base their location decisions on a cost analysis of constructing and maintaining the facility only. The economic criterion should additionally be related to suppliers and raw materials, utilities and infrastructure, the availability of new markets and personnel, and the economic aspects of transportation. For example, proximity and availability of raw materials and customers affects organizations which are surprised to realize that raw materials are too expensive or need to be imported from somewhere else when they choose to relocate based primarily on other factors. Telecommunication services, utilities, and other physical infrastructure including transportation should be available without necessitating large MNC investments. Many governments try to bring new businesses to their markets by offering significant tax
refunds, which can be attractive to MNCs. It is also important to have a stable currency and banking system, which can affect the organization’s finances long-term.

Finally, the specific physical site is chosen. Important decisions such as site size and cost are made. Related to the size, an organization should consider the growth possibilities expected for the near and distant future. Even if the organization does not have any expansion plans initially, the possibility should be left open to avoid conflicts later. The community where the facility will be established has certain characteristics that should match with the performance of the organization and vice versa. The organization must be aware of community needs, such as environmental aspects. Industrial parks should be evaluated to see if it is convenient for the organization to be located within one or not. Community receptiveness to new businesses and products should be analyzed and evaluated with a market study.

In this local area perspective, the transportation factor is considered again, including aspects such as how the organization is specifically going to receive raw materials and distribute finished products. It is important to note that it is often not until this point that many organizations consider the transportation factor in detail and as an independent factor, which is a risk if a flaw or deficiency is now found. Having a completed analysis from the global perspective without considering transportation may be a waste if, in the end, transportation problems are found. If this occurs, two options remain, either starting the decision analysis again considering the problems found, or maintaining the current option with perhaps higher transportation costs and less than ideal system performance.

Finding a new facility site is risky and each factor can be interpreted as either an opportunity for competitive advantage, or a risk factor requiring awareness and attention. Therefore, risk management is essential to compare the value that an organization is expending and the potential benefits that can result. These analyses of previously proposed facility location decision factors are made in order to assess the current consideration of the Transportation factor, which has generally been at the site specific level.

Additional Transportation Related Factors

Figure 1 organizes and classifies facility location decision factors in a new way, as compared to other authors. It allows for easy identification of the perspective level and timing of how each factor should be considered in facility location decisions. However, there is also a need to incorporate additional quantitative factors into a mathematical model to solve the location problem for MNCs. One of these important factors is capacity, both of the facilities themselves and also of the transportation carriers. Aspects regarding the routes must be included, such as existing availability, potential for new routes, transportation time, cost estimates, route distances between nodes, and so on. The availability and capacity of vehicles in each transportation mode must be present. Transportation modes such as air, rail, roads and maritime may be available which each have different characteristics represented by specific parameters. Therefore each possible transportation mode should be thoroughly analyzed and considered. Several of these new factors are elements of the more general Transportation factor, which must be assessed in greater detail in order to reach a more accurate facility location decision.

In a structural network configuration, the Transportation factor must be considered during earlier stages of the decision process in order to have a more appropriate final solution. Furthermore, some other authors have considered the Transportation factor as if it is one easily assessed factor, when in reality it is not. The Transportation factor can be subdivided into many categories that have to be considered independently in the mathematical model as well as in the qualitative analysis. Transportation is a factor that relates a network to its external environment, therefore incorporating it into the model will provide enhanced adaptability and flexibility that a structural supply chain network possesses.

It is essential for multinational corporations to consider, at the beginning of their location decisions, factors that significantly increase costs if not given sufficient attention. Cost is one of the most important considerations for companies when they are locating a new facility. Cost, however, has often been interpreted only as direct costs associated with building the facility, paying the employees, or satisfying customer demands, which only represent costs that are associated with the internal functionalities of the organization. It is important to consider the MNC’s external relationships and its interaction with the
Transportation Services offered in the new location. According to Bergmann and Rawlings (1998), a 1996 study of U.S. organizations estimated that transportation costs represent over 50% of total logistics costs.

Globalization requires closer interaction between the supply chain of MNCs and the transportation network. Integrating the transportation factor into decisions which affect the supply chain is the key to developing better communication and knowledge between the two networks. Greater integration of these two networks implies that entities on each side will know each other in greater detail, incorporate this knowledge into strategic decisions, and iteratively redesign their organizational structures accordingly. From the business point of view, knowing a customer or a market represents a competitive advantage to meet their needs. Understanding the relationship between the Global Transportation Network and the MNC supply chain network would similarly lead to considerable benefits for both sides.

**Integrating Factors into Models**

Once the factors are identified, the next step is to decide how these factors can help a multinational corporation with their facility location decisions. Several models have been developed by researchers which present different perspectives on the same problem. This analysis presents some of these ideas and identifies further work that would incorporate a more structural perspective of network interdependencies.

Ambrosio and Scutella (2003) define the integrated distribution network design problem, where decisions regarding facility location, transportation, and inventories are involved in a complex system. They consider distribution networks to be composed of four layers: plants, central transportation network, regional transportation network, and customers or demand points. Their aim is to define the number and location of different facilities in order to design a new distribution network or to improve an existing one. They base their analysis in the minimization of facility, warehousing, transportation, and inventory costs.

Drezner and Wesolowsky (2002) present the network design problem which considers potential links. Each link can be built as one-way or two-way, and the combination of both generates a mixed link (ML) problem. The two decisions considered are: 1) which links to build, and 2) whether those links should be one-way or two-way. If the links are one-way, then the directionality must also be determined. The objective is to minimize the total construction and transportation costs.

Daskin and Melkote (2001) discuss two different models, the uncapacitated facility location/network design problem (UFLNDP) and the capacitated facility location/network design problem (CFLNDP). Assumptions for both problems are almost the same except for the capacity restrictions. Some of the common assumptions are that each node represents a demand point, facilities can only be located at unique nodes, and only one facility may be located per node; however the UFLNDP is able to satisfy an infinite demand. In the CFLNDP, this last assumption changes so that facilities will be operating significantly below their maximum capacity. The results obtained from both types of problems show that the capacitated model brings more advantages such as the decrease on link and transport costs; however the network itself is denser and therefore more expensive. Only the capacitated model will be further analyzed, as it better represents reality.

From these three models, there are some factors which are common and others which are unique for each analysis. In general, the common factors in each model are: demand, nodes, links and costs. Within some other models, it is possible to find different quantitative elements such as: capacity, vehicles, inventories, distance, throughput, and routes, among others. An issue to be aware of is that there are several simple models that only consider the transportation factor as a cost of going from point $X$ to $Y$ ($c_{ij}$), ignoring the fact that transportation is a complex factor with multiple aspects that should be incorporated in the decision process. In future work, a combination of these elements will be integrated into a model which will be consistent with the structural network configuration.

When a decision has been made using a quantitative model, it is also important to support it with a qualitative analysis. Schniederjans (1999) suggests some methods which can be classified as Scaling, Scoring or Ranking. Some of the specific possible methods include the Analytic Hierarchy Process (AHP), Mathematical Programming, Heuristic Algorithms (Tabu Search) and Simulation methods.
Impact for Transportation Networks

The introduction of the transportation factor into the facility location decision will produce an impact on both sides: the supply chain network of MNCs as well as the Global Transportation Network. Bergmann and Rawlings (1998) stated that “shipment plans cannot be developed in isolation” which confirms the need for interaction between these two networks and that this relationship affects both sides respectively. Furthermore, Haider and Miller (2000) performed a study to evaluate the impact of transportation infrastructure and location on residential real estate values. The results of the study indicated that proximity to transportation infrastructure such as highways and public transit does influence real estate values when it is evaluated with only that factor. When other variables were considered, however, the influence of the transportation factors was not as strong as before. With this example, it is possible to see that transportation could affect location decisions to varying degrees, both for personal real estate and MNC facilities, and should thus be considered and given appropriate weight.

There are two networks being observed: the MNC’s supply chain network that represents a set of transformation and transfer functions and the Global Transportation Network that represents both physical infrastructure and logistics and transportation providers. One of the most notable impacts for both networks will be the system’s flexibility as well as the flexibility in some of the system’s components. Several types of flexibility related to these two networks and their elements are identified in Table 1.

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<tr>
<th>Concept</th>
<th>Description</th>
<th>Source</th>
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<tr>
<td>2. Transportation Flexibility</td>
<td>Ease with which transportation network can adapt to different circumstances and demand variability related to the available infrastructure.</td>
<td>Feitelson &amp; Salomon (2000)</td>
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<tr>
<td>2.1 Node Flexibility</td>
<td>Ease and cost with which nodes can be built and connected, and the available capacity that can be adapted according to environment variability.</td>
<td>Feitelson &amp; Salomon (2000)</td>
</tr>
<tr>
<td>2.2 Link Flexibility</td>
<td>Ease and cost of building a link between network nodes and their available capacity.</td>
<td>Feitelson &amp; Salomon (2000)</td>
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<tr>
<td>2.3 Temporal Flexibility</td>
<td>Ability to sequence infrastructure investments and the degree to which the use of the infrastructure requires coordination among users.</td>
<td>Feitelson &amp; Salomon (2000)</td>
</tr>
<tr>
<td>3. Manufacturing Flexibility</td>
<td>Ability to adapt the operating environment to produce quality products in a timely manner at a reasonable cost in response to uncertain market conditions.</td>
<td>Sethi &amp; Sethi, (1990) Gupta &amp; Somers (1992)</td>
</tr>
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When the two networks overlap, these flexibilities increase and enhance the MNCs competitive advantage. The increase in flexibility allows the supply chains to be more adaptive to the variability and uncertainty of the environment and of the demand. Both, variability and uncertainty may increase due to changes in manufacturing and product design decisions based on mass customization requirements. Uncertainty may also be related to factors such as world politics, natural disasters and economic fluctuations, among others. The reduction of these negative influence factors and the increase in flexibility will help both sides of the network to be more responsive against changes, which may be reflected in performance assessment through the reduction of lead times.
Having a structural relationship among networks will allow for better reciprocal communication among them, which will be reflected in improvements in deliveries, routing and scheduling; reduced costs; reduced misunderstandings; higher quality of information; increased transportation efficiency; and many other benefits for both networks. With improved routing and scheduling, multinational corporations will have better production planning and deliveries to their customers, ultimately leading to higher fill rates and customer service levels. A structural relationship between networks will also benefit the transportation carriers because their systems will be more aligned with those of MNC supply chains and thus, more efficient. These improvements will have results reflected in better coordination and optimization of these activities within MNC supply chains and between the two networks. Higher quality of information will only happen if both networks are willing to work together utilizing their combined strengths to contribute to network needs. This will also allow the transportation carriers to integrate their requirements with supplier and customer shipment requirements and necessities, which will simplify the coordination efforts of MNC supply chains.

Another impact which is beneficial for both parties is that as the networks are more closely aligned structurally, it is possible to maximize vehicle utilization, which will represent a significant cost advantage. In this way, structural interdependencies become possible, where the MNCs redesign their supply chains to better align with the GTN and vice versa.

A factor that can impact the mode of transportation and that must be considered is the type of product that is being transferred. Aspects such as the weight and size of the product, as well as a perishable or hazardous nature, can appreciably affect transportation decisions. Furthermore, product customization may also influence the transportation mode selection, considering that with greater variability in market demands, shipment quantities for an individual product variant are drastically reduced. Thus, less than truckload (LTL) or even single package shipments become more common. With these examples, it is possible to see how an improved relationship of the two networks will result in benefits for both of them.

Some MNCs now outsource logistics and transportation services to external companies who offer to retrieve and deliver products as needed and therefore undertake all of the transportation responsibilities and risks. When these third party logistics, or 3PL, organizations relieve the MNC of responsibility related to Supply Chain Management, by providing a cost effective and reliable service, the system dynamics change and a new entity connects to the existing elements of the two networks. Information flow paths are adjusted, so that they come first from the MNC to the outsourcing company and then from the outsourcing company to the transportation services, going back and forth through an intermediary. This can potentially provide savings in time and performance improvements for the MNCs, but should be further analyzed to see if it is really more convenient and feasible to integrate a new party into the two network system, according to the structural network configuration.

There are tools which can help with the synchronization of both networks, such as real time Electronic Data Interchange (EDI) systems. This allows for ease of communication among corporations, suppliers, customers and transportation carriers. As an example of the benefits that these systems bring, shipments can be more easily tracked by any entity in the system and all parties have greater information about system status through data transparency and availability. The downside is that certain entities may not want to risk revealing proprietary information that represents a competitive advantage for their organization, such as the exact location of carrier vehicles, or the gross sales volumes on a given day.

Considering that demand is a continuously changing variable, multinational corporations must have systems and analysis methods in place which will help them to develop their logistics tasks to satisfy customer requirements. Actions taken by MNCs in this type of situation directly affect the transportation service’s reaction. Many of these situations are controlled by the analysis of historical performance data which helps forecast future requirements. Because of this, it is important that system data originating from each of the networks is accurate, and does not get lost or obscured within daily operations. It is easy to have miscommunications considering that there is so much information going back and forth, which provides another reason for closer contact among network entities.
Relationship with Other Countries

Conflicts exist between selecting sites in developed or developing countries for a new facility location, which should be taken into account during the early stages when the MNC is still applying a regional perspective level. It is important to consider both developed countries where the MNC already has a presence, as well as countries that are just starting to develop their infrastructure. Some regions might be known for their low labor costs; however, they might not have enough transportation infrastructure to support a MNC facility, thus requiring a balance or tradeoff. It is essential to have an established Transportation network, including the existence of ports, roads, rails, or airports, or at least a plan to develop them before even starting new facility construction. An MNC must consider where the headquarters and support offices will be located when decisions are being made to relocate production facilities to achieve cost savings. Relocating production facilities will increase demands on receiving regions which may or may not have adequate infrastructure support in place. In addition, transportation demand will be negatively affected near facilities that are closed.

An example of a MNC which has worked with the concept of a structural supply chain network configuration is Toyota. Toyota has been working with Lean tools for many years. Among them, one of their principles has been to establish partnerships with their suppliers to build factories near final assembly facilities in order to minimize transportation costs. These agreements allow both parties to have improvements related to costs, deliveries, responsiveness and communication. The partnership is seen as a structural configuration considering that two different entities in the system are working together in the design of the network to gain a competitive advantage for both. One aspect that has made this feasible is that Toyota has been known to enter into formal partnerships with suppliers, such that each company has partial ownership in the other.

Multinational corporations might consider factors that are related to Transportation during a facility location decision without explicitly recognizing them as such. For example, there is an American company that packs perishable food with special refrigeration requirements for different holidays during the year, including Halloween, Christmas, Easter and Valentine’s Day. They sought a location for a new assembly facility and two important factors they considered were the temperature and relative humidity range at each potential site. Other factors were related to low labor costs and proximity to their suppliers. It is relevant to point out that one of the options was a city very close to a seaport, which was desirable because of its easy access for one of the suppliers located in China. Selection alternatives were among several cities in Latin America and the final decision was for the one that had on average the coldest temperatures throughout the year and consequently, less humidity. The MNC found that they would not need to invest as much in special refrigerating systems and that product quality would be better in more moderate temperatures. Consideration of proximity to a seaport was discarded and the priority of other factors was elevated. In this case, transportation factors were not fully incorporated into the decision analysis, given that the perishable nature of the product will later affect the transportation mode by which the product travels from suppliers to the new assembly facility and then through distribution channels to their global customers. This MNC must also somehow coordinate with transportation suppliers in order to accommodate the cyclical nature of their product demand cycles, which surge just before any holiday and are lower during other times of the year.

The factors that have been mentioned can vary depending on the areas of the globe where the MNC operates. Details related to each region should be known in order to make an accurate decision. A factor that can represent an inconvenience when choosing sites around the world is differences in time zones, or can even limit the number of prospective sites. For example, MNC facilities located in the Northeastern US will have only a four hour window in which to deal with MNC facilities in Western Europe, which is quite small. Another aspect to think about when observing different countries or cultures is that the transportation network as a whole may not only be different in terms of how it functions, but also in terms of how it is ruled or regulated by local laws and conditions.

Factors may as well differ among continents when related to cultural and technical issues. Asia, which many years ago was isolated from commercial relationships, is now a continent that is rising in low
cost and high technology suppliers, and is thus winning markets from all over the world. On the other hand, many of the African countries are not yet creating that same competitive advantage worldwide and need to be developed more internationally and incorporated into the commercial cycle. Technology is a factor that directly influences system responsiveness, including the speed of deliveries that originate from a given region, which can represent a competitive advantage for a certain country or MNC.

Due to globalization, commercial restrictions that block a particular country or MNC from operating in any area of the world are rare. Now, the primary restrictions that exist have shifted to security related issues. For example, after recent acts of terrorism worldwide, the security response in the U.S. has led to more strict control of customs transactions, as well as personal travel. This affects the entrance and exit of certain transportation modes to varying degrees. Information systems among networks will be essential for strengthening the response of the system’s functionality. In some countries, regulatory constraints can be relaxed when sufficient trust exists between the transportation carriers, the MNCs, and the government.

**CONCLUSIONS**

After the identification and discussion of some of the most important factors that influence facility location decisions, Figure 1 shows these factors classified using Porter’s Diamond Model. This figure is then analyzed to see if the factors are located at the appropriate perspective level for multinational corporations involved in facility location decisions. From Figure 1, it is possible to see that the Transportation factor has in the past been located only in the Local Site perspective level. Physical infrastructure is located at the regional level, but neither of these fully captures the diverse range of transportation factors that actually exists. In order to improve facility location decisions, it is suggested that Transportation factors also be considered at other levels, starting with the analysis from the Global perspective level. Transportation can become a global factor that allows MNCs to capitalize on strategic advantages by linking with the global transportation network.

Previous authors and their analyses had mentioned Transportation as one simple factor, but many aspects, both qualitative and quantitative, contribute to this matter, transforming it into a more complex concept. Some of the aspects that are related to Transportation are: availability and reliability of diverse transportation modes and infrastructure; existing capacity in links, nodes, or transportation modes and vehicles; maximization of vehicle utilization; improvement of routing and scheduling performance; climate; community culture and attitudes; regulations and quality standards; and others, along with the more traditional factors of distance, demand, and cost. Therefore, when a facility location decision is made, all of these factors must be incorporated and thoroughly analyzed.
REFERENCES


Acknowledgements

The authors gratefully acknowledge support from the University of Rhode Island Transportation Center.