INLAND PORT LOCATION MODEL UNDER TRANS TEXAS CORRIDOR CONCEPT

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by

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Abstract

Inland Port Location Model under Trans Texas Corridor Concept

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Trans Texas Corridor (TTC) is a proposed multi-use, statewide transportation corridor that is aimed at moving people and goods more safely, efficiently and reliably than the inter-state highway system. Inland ports are the locations where the processing of trade can be shifted from national borders and where multiple modes of transportation and a wide variety of services can be offered at a common location. Connecting freight corridors under the Trans Texas Corridor Concept to metropolitan areas through inland ports presents unique opportunities and challenges. This research discusses unique features of TTC as it brings forth benefits to freight transportation. Two special topics are particularly emphasized in this research. One is to develop a Multiple-Attribute Decision Making (MADM) method for selecting the most acceptable inland port sites among a set of candidate sites under multiple potentially conflicting objectives in a group decision-making environment. A case study in El Paso area is presented to demonstrate the computational process of the proposed approach. Another one is to consider inland port selection from investment perspective. A mathematical model which is composed of multi-objectives is developed to resolve this problem. The Multiple-Objective Decision Making (MODM) method combining MADM method is selected to solve this model. Finally, a case study is applied to validate the whole process.

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CHAPTER1: BACKGROUND INFORMATION AND INTRODUCTION

1.1 BACKGROUND INFORMATION

This section begins with an introduction of Trans Texas Corridor (TTC). The second part educes inland port. The relationship between inland port and TTC is also discussed in this part. Finally, this part concludes with a review of importance of inland port location.

1.1.1 Trans Texas Corridor (TTC)

The state of Texas historically plays a crucial role for the United States domestic and North America trade because of its geographical locations as well as social technological capabilities. Over the past decades the dramatic increase in trade has both benefited and hindered markets that are influenced by the International Highways system of this state. With increasing traffic, congestion has became to imposed detrimental influence on Texas's economics growth and,. "The Interstate system was viewed not only as a way of increasing personal and defense mobility, but also as a catalyst for the economic development of the state….Unfortunately, *the success of the Interstate has now led to a decrease in mobility within Texas' major urban areas (Gonzalez-Ayala, Euritt et al. 1996).*" As solutions to the ailment of congestion, several projects have been proposed in order to accommodate the predicted increased traffic problems of the state.

One of these projects is the Trans Texas Corridor (TTC), an all-Texas transportation network of four corridors comprised of three major components designed to move people and goods faster and safer than ever before. The planning and work

involved in the corridor will far exceed any public works project in the state's history. The proposition for this project was introduced by the Texas governor in 2002. It appears quite clear that the Managed Transportation System (MTS) concept proposed by Gonzalez-Ayala et al. (1996) has influenced the conceptualization of the TTC, and the MTS in a form was modified in several ways to become more understandable to the public (Harrison, Chiu et al. 2003). In the middle of 2002, the development of the TTC has taken the first step from existing only as a concept to becoming an implemented project. As of February 2003, the Texas Transportation Commission has encouraged the Texas Department of Transportation (TxDOT) to investigate options to develop the first corridor(s) (TxDOT 2004). In the month of March, an official notice was published informing TxDOT to draft a request for competing plans for the development of particular sections of the corridor. This notice was initiated due to a proposal submitted by Fluor Enterprise in December 2002 with its interest to develop and finance portions of I-35, I-37, and I-69 corridors. Most importantly, the first series of county public hearings hosted by TxDOT throughout the state started in February 2004.

At its current status, federal environmental studies for both the Oklahoma to Mexico/Gulf Coast (TTC-35) element and Northeast Texas to Mexico (I-69/TTC) have begun in early 2004. These studies will cover broad expanses of land within which each route might be built. Since 2004, the Texas Department of Transportation (TxDOT) conducted 117 public meetings within the TTC-35 environmental study area. More than 6,000 people attended 47 meetings held in early 2005. A series of public meetings on I-69/TTC will be held in 2005 summer. After completion of all environmental studies, FHWA will determine whether TTC-35 and I-69/TTC will be built, and if so, the specific

location for each route. Currently, the Texas Transportation Commission has selected the private-sector firm, Cintra-Zachry, as the consortium to develop TTC-35. Cintra-Zachry is offering to invest $7.2 billion in TTC-35. In 2005 spring, the TxDOT Texas Turnpike Authority Division (TTA) and the FHWA have concluded that the I-69/TTC study area should be enlarged so more corridor alternatives can be considered. The largest study area expansions are west of Houston and between Laredo and Corpus Christi. The Laredo, McAllen, and Brownsville metropolitan areas were also included to coordinate local transportation planning with TTC planning. Meanwhile, the Trans-Texas Corridor Advisory Committee come into existence and committee members are selected by the Texas Transportation Commission in March, 2005.

According to the initial plan, the TTC network of corridors up to 1,200 feet wide will run parallel to I-35, I-37 and I-69 (from Denison to the Rio Grande Valley), I-69 (from Texarkana to Houston to Laredo), I-45 (from Dallas-Forth Worth to Houston), and I-10 (from El Paso to Orange). For a visual picture refer to figure 1-1. The first component of the 4,000-mile corridor will include separate highway lanes for passenger vehicles and trucks. Separating these two types of vehicles introduces improved safety and less congestion, due to their distinct vehicular performance characteristics, which require different considerations in highway planning, design and operation. As a result, the truck lanes with specially designed pavement, may allow trucks, specially designed double-sized and double-weighted multi-trailers, to potentially operate, more safely, efficient and cost-effective than the current existing truck sizes and weights. The second component is rail lines for high-speed commuter rail and high speed freight rail. In total the corridor will have 16 lanes: three passenger vehicle lanes, two truck lanes, and three

rail lines in each direction. The final component is a 200 foot wide dedicated utility zone. This zone will feature the transmission of oil, natural gas, electricity, data, and water that will be provided to areas of the state (TxDOT).

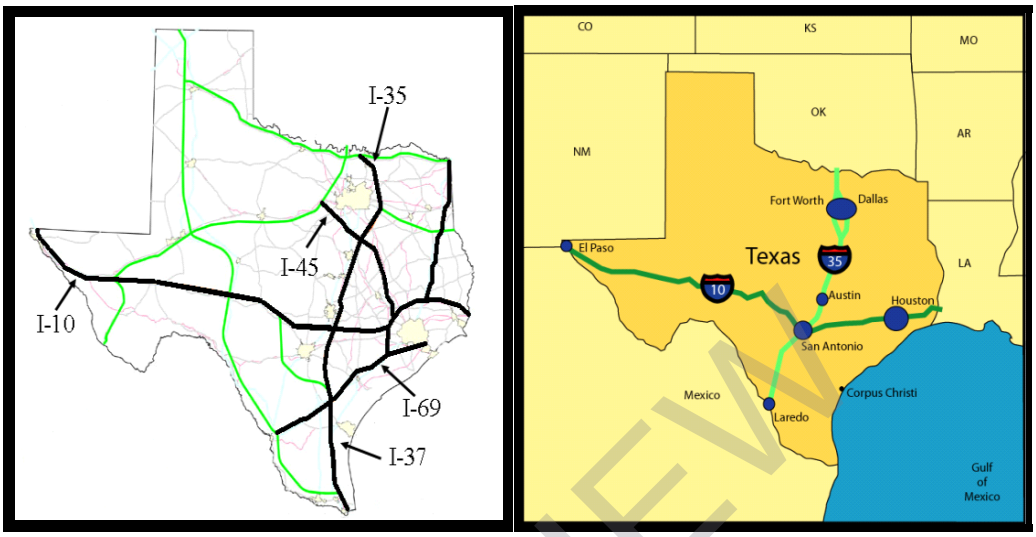

Figure 1-1 Trans Texas Corridor (conceptual planning) and Major Texas Trade Corridors

Depending on the foremost description, the TTC will be one of the state's largest transportation assets. Based on an estimated cost of $31.4 million per centerline mile, the 4,000-mile corridor would cost $125.5 billion, not including right of way and miscellaneous costs. Factoring in right of way at $11.7 billion to $38 billion and miscellaneous costs at $8 billion to $20 billion, the estimated total cost for the TTC would range from $145.2 billion to $183.5 billion. The TTC will be financed with the support and resources of the private sector along with tolls, bonds, limited state funds and other revenue sources. Currently, financing plans for TTC-35 are under development.

1.1.2 Inland Port

The introduction of TTC's network of corridors, operating parallel to the Interstate Highways, raises the issue of integrating/interconnecting trade and passenger

flow with the existing infrastructure in the state. As a result, TTC corridor segments require interconnection with additional modes of transportation to enable passengers and freight to reach their final destinations in nearby cities(TxDOT). The requirement of distributing centers as venues for mobility and shifting of commerce along the corridor introduces inland ports as the best candidate for complementary corridor nodes.

An inland port is a location where the processing of trade can be shifted from the national borders and where multiple modes of transportation and a wide variety of services are offered at a common location. International operations are supported at and inland port when customs clearance and Foreign-Trade Zone capabilities are available. Inland ports that provide value-added services in addition to trade processing will support industry efforts to create more efficient supply chains. As for TTC, inland port will enable operations executed within the corridors to be supported more efficiently by the inland ports thus creating dependable supply chains that contribute to the promotion of cost-effective trade. Inland ports appear to offer a number of attractive attributes to shippers and may complement the transportation corridors they serve by raising service levels and lowering total cost (Harrison and Leitner 2002).

Inland ports contribute to the TTC in various ways. Inland ports complement domestic and global supply chains and can become an integral part of TTC transportation trade corridors by providing opportunities for increased service levels, value-added assembly/processing of imports and lowering total supply chain costs (Harrison, Henk et al. 2002). An inland port allows for the movement of freight at more efficient and lower costs due to its ability to provide a single stop location for the process of trade where multiple modes of transportation, warehousing, distribution, manufacturing and other

services, such as inspection stations, are available. This is demonstrated in the cases of two prominent Texas inland ports, Alliance and KellyUSA. Alliance, located north of Forth Worth and KellyUSA, located southwest of San Antonio, provide services that have created both economic growth and employment opportunities for their tenants and region. KellyUSA is the location of the Union Pacific rail yard allowing it to have direct rail access accommodating light-industrial development. A feature the inland port advertises is its emphasis on small business support and international business development. Alliance provides air, rail and highway as its transportation capabilities—producing a potent distributing center, encouraging manufacturing facilities to establish at the site. The advantages of having a strong manufacturing tenant, like Nokia in the case of Alliance, leads to a chain reaction of supporting industries locating at the center.

At this stage, the location of an inland port plays a major role, as it may bring forth issues of traffic (accessibility to the metropolitan area, congestions, etc.), environmental (air and water pollution, intrusion of environmental sensitive area, etc.), and economic (economic growth, employment, etc.) benefit/impact to surrounding areas. As location interests are revealed, the importance of considering criteria such as inter-modal freight and traffic assignment increases. Eventually, traffic volumes expected to frame TTC will impinge their effects on interrelated modes of transport. Individual modes, for example, can extend their dominating authority resulting in unfavorable conditions for other modes of transport. Mode disintegration is one of many caused events, unfavorably impacting economy, as traffic flows are improperly delegated or "monopolies" arise. Other important aspects such as available land size, construction

cost, environmental sensitiveness, public/private sector partnership, financing, subsidization, etc. also add to the complexity of the selection of an inland port problem.

1.2 INLAND PORT LOCATION PROBLEMS

Two distinct problems which are related to inland port location decisions are presented and discussed in this thesis. The first decision problem concerns with selecting one or several pertinent inland ports given certain selection criteria based on the existing infrastructure and/or operating characteristics of inland ports. In some cases, this will take the form of establishing upon an existing inland port site, while in other cases it will require the development of a green field site. The development of the inland port location decision model focuses on a decision process that incorporates pertinent selection criteria and various possible decision contexts based on the assumption that no investment is intended while making such an inland port selection decision as only existing conditions of these sites are considered..

Furthermore, the second decision problem concerns with the possible situation that certain amount of capital fund may be invested to improving/upgrading one or a number of existing sites in order to achieve certain objectives intended by TxDOT. This possible decision context may take place in a number of different ways. Under the current partnership arrrangment, the TTC development consortium may be allowed to non-exclusively invest or develop infrastructure related to the operation of TTC, including inland ports. Individual inland port operators may also choose to do so due to the potential benefit of linking with TTC. Regardless of actual investment scenarios, TxDOT strives to ensure that any inland port selection and investment decision leads to a

balance of proper investment return and improved efficiency of the TTC and surface transportation system.

1.3 RESEARCH OBJECTIVES AND CONTRIBUTIONS

The research objective of inland port selection decision is to develop a comprehensive method for selecting the most desirable inland port sites among a set of candidate sites under multiple potentially conflicting criteria in a group decision-making environment. The methodology developed by the present research is not only suitable for TTC related inland port location section decisions, it can also be applied to other similar transportation planning issues related to mega warehouses (big-box) that are gradually spreading across Texas by major logistic distributors .

The research objective of solving for the simultaneous inland location and investment decision is to help determine both the most appropriate inland port sites and respective investment level under the assumptions that existing infrastructure can be improved or upgraded in order to support the TTC operations.

Both the government agency's objective and private institution's investment return are integrated into this investment decision model, creating a multiple-objective decision problem. Present research attempts to integrate economic impact and social benefit as the estimation of the benefit of government (such as state DOT) as well as monetary return for the partnering institutions..

CHAPTER 2: LITERATURE REVIEW

2.1 SIGNIFICANCE OF INLAND PORT PLANING AND OPERATION

An inland port is a site located away from traditional land, air, and coastal borders with the vision to facilitate and process international trade through strategic investments in multi-modal transportation assets and by promoting value-added services as goods move through the supply chain(Harrison and Leitner 2002). Inland ports can complement global supply chains and become an integral part of transportation trade corridors by providing opportunities for increased service levels, value-added assembly/processing of imports and lowering total supply chain costs. By this definition, comprehensive planning process and appropriate operation procedure are vital for a well-developed inland port which is regarded as a general transportation infrastructure.

Generally speaking, inland port planning can examine the potential of future actions to guide inland ports toward a desired direction, for example, toward the attainment of positive goals, the avoidance of problems, or both. As a matter of practicality, planning is not a search for ultimate answers but only a means to specific ends based on the proposition that better conditions would result from premeditative as opposed to impulsive actions. The planning phase of inland ports consists of activities during the 10 to 20 year time frame when inland ports are considered to be in the initial stages of development. Therefore, planning status is reserved for inland port projects with high capital costs where the route studies, location selection, environmental impact concerns, and right-of-way considerations can take a substantial amount of time. Another key function of the inland port planning process is to stipulate for the funding categories that help guide the financial planning activities of inland ports. In addition, an important component of the inland port planning process is the

requirement that project information be made available for public review and comment. It is a good opportunity to get more public comments involved in the whole project.

Given a systematic inland ports planning process, a reasonable inland port operation procedure can turn into being doable. Inland port operation also plays a crucial role in the whole development process of inland port. Only if an inland port can be operated appropriately, can it have the capability to create local employment, enhance corridor efficiencies and thus trade competitiveness, and reduce both public and private costs. A proper inland port operation can not only provide an atmosphere where international trade can be facilitated, but also promote local and regional development. Furthermore, it enables inland port to provide valuable means for companies to reduce supply chain links, provide an avenue for community economic development, and allow transportation planners and policy makers to enhance corridor efficiencies through multimodal operations.

2.2 MULTIPLE CRITERIA DECISION MAKING (MCDM) IN FREIGHT TRANSPORTAION

Given the complexity of the problem and potential conflict of interest and objectives from multiple players, it becomes clear that traditional single-objective/criterion methods(Diasa, Eugenia et al. 2002),(Wang, Batta et al. 2002), (Taniguchi, Noritake et al. 1999),(Wang, Sarker et al. 2003) will not provide decision makers (DMs) with sufficient tools and/or guidance to make an informed decision. As such, the present research employs distinct features departed from these traditional methods.

Multiple criteria decision making approaches are regarded as methods that are capable of addressing various relevant aspects of criteria. Multiple Criteria Decision Making (MCDM) refers to making decisions in the presence of multiple, usually conflicting, criteria(Hwang and Yoon 1981). MCDM is a descriptive approach and as it consists of describing the problem: by defining the possible decisions, by defining the attributes and the

evaluation criteria, by incorporating in a utility function f the set of retained criteria(T'kindt and Billaut 2002),(Belton and Stewart 2002),(Doumpos and Zopounidis 2002),(Yu 1985). The field of decision support for multiple criteria problems has advanced significantly in the last 20 years(Shim, Warkentin et al. 2002). The techniques are used in a wide variety of application domains(Gillianms, Raymaekers et al. 2005),(Carmody, Kristof et al. 2005),(Ghazinoory 2004),(Ulutas 2003).

In the research field of transportation, MCDM has also been introduced widely on the aspect of freight transportation. As mention of freight transportation, multi-criteria shortest-path problem is always hard to solve. Skriver drew MCDM theory into this problem(A.J.V.Skriver and K.A.Andersen 2000). By implementing and testing different algorithms, a theoretical argument of the performance of all the existing algorithms was made in order to rank them by performance. Some other topics relating to freight transportation also have been proved to have tight interaction with MCDM. Davis's report described how MCDM may be used in conjunction with transportation system modeling techniques to select amongst alternative transportation corridor improvement options(Davis, Campbell et al. 1999). In addition, freight shipping company performance evaluation and strategic alliance selection in the linear shipping, street maintenance resource allocation evaluation can all utilize MCDM to perform a concrete and effective solving process(Chou and Liang 2001),(Ding and Liang 2004),(Bogardi, Zhang et al. 1998).

Despite diverse fields of development, MCDM methods have certain aspects in common. The four words are most used in a MCDM problem: attributes, objectives, goals and criteria. In other words, one MCDM problem can be a problem of multiple attributes, objectives or goals, criteria(Greiner, Winter et al. 2005),(King, C.S.Rughooputh et al. 2005),(Schlottmann, Mitschele et al. 2005),(Nicolini 2005),(Murata and Itai 2005). Apropos of present research, inland port location selection is a typical multiple attribute decision