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THE REVOLUTION: SMART INLAND PORTS FOR INTEGRATED SEA PORTS' LOGISTICS

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Abstract

Due to the fast growing rate of the global container trade, every major port is under the pressure of meeting the projected capacity demand. The scarcity of land at ports in many Metropolitan areas makes it difficult if at all possible to improve capacity by expanding the terminal area. As a result alternative solutions have been sought for improving capacity and meeting the growing demand for container storage area and terminal capacity.
Traditional ports at land, air, and coastal borders are the primary locations where international trade is processed. However, it is now recognized that a growing amount of trade is being processed at inland sites. International trade processing involves all transactions and inspections that federal agencies require for goods entering or leaving the country. 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 an 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.
The emergence of inland ports took place in several regions around the world, notably where the growth of inland freight distribution required a massification of flows. Yet, there is no definitive consensus about how such inland facilities should be labeled, with terms such as dry ports being advocated. It is suggested in the paper that the term inland port is a more appropriate construct since it considers terminal activities as well as the crucial logistics activities taking place in co-location or in proximity of inland terminals. This perspective requires the investigation of how transport and supply chain functions and the various actors involved in their setting and operations are taking shape in inland ports.

Keywords: Inland Ports (Terminals), Dry port, Sea port inland access, Intermodal terminal, Logistics, Containerization, Freight distribution.

1. Introduction:

The establishment of Dry port is a useful method to solving the shortage of the space in the sea port areas. In general Dry port provides services like storage, maintenance, repair for containers, consolidation if individual container flows and custom clearance. At the same time, it can reduce the transport costs and expand rail transport.

Dry port can improve the situation resulting from increased container flows. In the dry port goods can be turned in as if at the seaport. The concept of the dry port is based on a seaport directly connected by rail with inland intermodal terminals. To build a dry port, the location must be carefully evaluated so as to obtain strategic advantages over competitors.

The new phrase of Inland port was raised in order to include the new role of the river ports through modern supply chain and to conduct the new trend of the multimodal transportation through the sea port logistics.

The role and function of inland ports has been the object of some confusion since there is no specific conformity, even concerning the definition of the term itself. Although inland freight distribution has been taking place since the industrial revolution, developments in intermodal transportation since the 1970s favored the setting of inland terminals performing functions that are synchronized with global supply chains. As inter-modalism was dominantly taking place at ports and over maritime shipping, inertia induced to consider the development of inland freight activities from a maritime standpoint. For instance, the term "dry port" is often used to refer to a terminal where various cargo handling and added value activities are performed, connected to a seaport with either rail or barge services. The term dry port is also subject to contention as "dry" appears to exclude inland terminals serviced by barges. Further, it has been argued that coastal terminals solely serviced by feeder services can functionally be an "inland terminal" as far as the hubs they are connected to are concerned. A wide variety of scales is also observed as some inland ports are just simple terminals while others are complex entities that include logistics zones and a governance structure, such as a port authority.

2. Port Terminology:

It seems that there is some confusion in applying the terms port and terminal. Therefore, prior to delving into technical discussion, there is a need for the classification of the terminology to be used. A port is composed of several terminals, or the terminals are components of a port.
In reality, however, the term **port**, being the more general term, is used more often than terminal. Consequently, in the following sections, the term port will be used as the general term, while terminal will be used only in the context of specific operation within a port.

Dry port[1] means that most containers are moved by rail, road and airport from cities to seaport. Furthermore the development of dry ports is an essential possibility to promote sustainability and effectiveness of goods transport in sea related transport chains.

In the **inland/dry ports** large goods' flows can shift from road to more energy efficient traffic modes. Furthermore, a dry port can provide services such as storage, consolidation, depot, custom regulation and service, maintenance of containers, and customs clearance, so it can relieve seaport cities from some of the congestion, make goods handling more efficient and facilitate improved logistics solutions for shippers in the port's hinterland.

To be an inland/dry port, a place must fulfill some conditions such as; it should locate near a developed city, have direct connection to a seaport either by river, by rail or by road, have a high capacity traffic mode, have the abundant human resources.

[1] www.unescap.org/ttdw/Publications/TPTS_pubs/bulletin78/b78_fulltext.pdf (Accessed June 2010)

Inland ports are beginning to attract attention because they can provide the means to optimize transportation-related costs associated with supply chains. By providing multi-modal combinations at inland ports, new opportunities to control efficiency are introduced. Additional opportunities occur when "value–added services" are located at an inland port.

At inland ports, transportation capabilities in the form of access to the interstate highway system, intermodal rail facilities, or air cargo operations are viewed as building blocks for businesses seeking competitive advantages. They allow businesses the feasibility to choose the appropriate modal alternative(s) for their logistics needs. As supply chains become more complex, businesses look for ways to reduce the number of links in the chain by incorporating a variety of components at locations such as inland ports. For example, when distribution, warehousing, and manufacturing are located together at an inland port, uncertainties related to "just-in-time" systems are reduced. These uncertainties could relate to customs processing and border delays, which can be reduced at an inland port because these functions can be better managed at the inland site. Overall, an inland port can be seen as a location where transportation capabilities, combined with value–added services, allow businesses to compete more effectively.

As supply chains become more complex, companies do not only look for ways to reduce the number of links in the chain to minimize transportation costs but ways to reduce links by other means. The elimination of links can also be accomplished at an inland port where value added services are provided amidst strong transportation capabilities. When distribution, warehousing, and manufacturing work together at an inland port, uncertainty related to JIT systems will be reduced as well as other uncertainties integral to supply chain components. Other uncertainties related to customs and border delays can be eliminated at an inland port because these functions are all commonly located at one site.

> *"Overall an inland port can be seen as a location where transportation capabilities, combined with value-added services, can allow business to compete more effectively".*

3. Inland Terminals[2].

A rail or a barge terminal that is linked to a maritime terminal with regular inland transport services. An inland port has a level of integration with the maritime terminal and supports a more efficient access to the inland market both for inbound and outbound traffic. This implies an array of related logistical activities linked with the terminal, such as distribution centers, depots for containers and chassis, warehouses and logistical service providers.

Since the inland terminal is essentially an extension of some port activities inland, the term "dry port" has gained acceptance. However, using this term to

2 http://www.porttechnology.org/images/uploads/technical_papers/PT50-04.pdf (Accessed May 2010)

define an inland terminal is subject to debate since many inland terminals are in fact 'wet' given their direct access to inland waterway systems. Moreover, the inland location can effectively be a port if a barge service is concerned, but fundamentally cannot be considered a port if it involves a rail terminal. Thus, there seems to be no consensus on the terminology resulting in a wide range of terms including dry ports, inland terminals, inland ports, inland hubs, inland logistics centers, inland freight villages, etc. The reason for this lies in the multiple shapes, functions and network positions these nodes can have. A similar issue applies with the inclusion of airport terminals, mainly the freight component, as an element of an inland port.

A whole array of transport terminal infrastructures is therefore often presented as a dry port[3]. Regardless of the terminology used, three fundamental characteristics are related to an inland node:

- An **intermodal terminal**, either rail or barge that has been built or expanded.
- A **connection with a port terminal** through rail, barge or truck services, often through a high capacity corridor.
- An array of **logistical activities** that support and organize the freight transited, often co-located with the intermodal terminal.

The functional specialization of inland terminals has been linked with **cluster formation** of logistical activities. Inland terminals in many cases have witnessed a clustering of logistics sites in the vicinity, leading to a process of logistics polarization and the creation of logistic zones. They have become excellent locations for consolidating a range of ancillary activities and logistics companies. In recent years, the dynamics in logistics networks have created the right conditions for a large-scale development of such logistics zones.

3.a. Basic Requirements for Inland Ports

A rail-based inland port has three basic requirements; an intermodal terminal, logistics activities and a corridor to a gateway. The principles of economies of scale (massification of flows) and agglomeration provide multiplying effect. Particularly, a high capacity intermodal corridor and an efficient terminal help reduce transportation costs and therefore benefit the inland port's customers, which are mostly logistics activities. The principle of co-location provides additional value to an inland port, particularly by minimizing drayage.

3.b Main Advantages of Co-location for an Inland Port

Most of the dry ports initially developed where intermodal facilities acting as nodes of convergence for regional freight distribution enabling a modal shift away from road and freight diversion away from congested areas. These two key paradigms have been expanded with a more comprehensive approach leaning on the principle of co-location. As dry port project become increasingly

[3] www.porttechnology.org/images/uploads/technical.../PT50-04.pdf (Accessed Feb. 2011)

capital intensive and prone to risk because of their size, required equipment and infrastructure, the need for a higher value proposition is now set on the principle of co-location, many of which are public private partnerships. The most common actors in a typical co-located dry port project involve a railway operator and a commercial real estate developer, or a local public development office. Co-location therefore expands the market opportunities of the intermodal terminal through a set of value propositions:

- **Real estate**. Logistic zone projects tend to occupy a large amount of space to accommodate existing and anticipated freight distribution activities. Most co-located projects occupy at least 250 acres and several projects are well above 1,000 acres. Larger projects tend to have lower land acquisition costs. Also, since co-located projects involve at least two large players, a commercial real estate developer and a railway company, they are able to tap into capital pools with better conditions than a smaller actor (e.g. interest rates).

- **Specialization**. A co-location project enables both actors involved to focus on their core competencies, creating multiplying factors. For instance, the rail company can focus on terminal development and operations while the real estate promoter can develop and manage the freight distribution facilities.

- **Interdependency**. Both the terminal operator and freight distribution activities at the logistic zone are their respective customers, implying that both partners have vested interests in the efficiency of their operations. The possibility of joint marketing where the logistic zone is promoted as a single intermodal package is also common since the terminal is sold as a value proposition to potential customers.

- **Drayage**. A co-location project offers notable operational advantages for drayage, not just because of close proximity, but because trucks can have a priority access through the terminal's gates (e.g. pre-registration, advance notification, RFID). Drivers are able to perform more deliveries per day and the reliability of these deliveries improves.

- **Asset utilization**. Intermodal transportation assets are capital intensive and there are pressures to increase their utilization level to achieve better returns on investments. Containers and chassis tend to be the assets that are the most prone to such strategies, namely through the setting of chassis pools and empty container depots.

- **Information technologies**. A co-location project offers the possibility to jointly plan information systems for terminal operations and the related supply chains, creating a community system where users can have access to real time information about the status of their shipments. Both terminal operations and their related supply chains benefit.

One drawback is that co-located logistics activities are dependent on the performance of the terminal as well as the level of service offered by the rail operator. If for any reason the rail operator has other priorities within its network, then the efficiency of the co-located logistic zone is compromised.

3.c Modal Shift and Freight Diversion

In time, many transport terminals have become surrounded by various economic activities, many freight related, which poses challenges in terms of local road access. Congestion and terminal access becomes increasingly problematic. The problem is compounded if the terminal is surrounded by a large metropolitan area, as most ports are. To cope with a growing level of congestion which undermines the reliability of freight distribution as well as imposing additional costs and delays, two interdependent strategies can be implemented:

- **Modal shift**. Shipments entering or exiting the terminal are using a mode other than road, which commonly involves barges or rail shuttles. These modes are likely to be much less congested.
- **Freight diversion**. Satellite terminals enable the interception of freight shipments which instead of **entering** a congested metropolitan area is bound to terminals easier of access. This can also have the advantage of expanding the hinterland of the terminal.

3.d Inland Terminal Life Cycle

An inland terminal, like most transport infrastructure, has a life cycle that involves a sequence:

- **Planning**. In this stage the business opportunities of an inland terminal are considered. This involves the identification of potential sites, the costs incurred as well as the search for potential users and sources of financing. Consideration should also be made to the size of the facility, its governance, its integration with a logistics zone and its insertion within local, regional and global systems of freight circulation.
- **Setting**. Once a decision has been reach about the terminal site, construction of the facilities takes place, often in different expansion stages. This marks the setting of the first users, some of them can be transitional (e.g. taking advantage of cleared land for storage purposes before other facilities are constructed).
- **Growth**. The inland terminal quickly develop its market potential which will be proportional to its sitting within local, regional and global freight distribution systems. New users decide to use the facility and/or locate in the vicinity, which favors clustering and the development of logistical poles generating added-value to freight distribution.

- **Maturity**. At some point, the market potential of the inland terminal is reached and traffic and revenue generation reach a peak. Most of the development zone is now occupied and few new users arrive, often to replace users that may have left. This is also the phase that sees rising costs due to real estate pressures and congestion of the terminal facilities and its accessibility to the regional transport system. Since the inland terminal has become a node of economic activity, many other forms of real estate development take place in proximity, notably housing and retail. This has the potential to increase externalities and public pressures to mitigate them.
- **Decline**. Because of changing market conditions (e.g. new competitors) and rising externalities, the efficiency of the inland terminal for several freight distribution activities is compromised. This involves the departure of several users and attempts to have some elements subsidized (e.g. tax credits or infrastructure provision) in order to reduce operating costs.

4. A New Role for Inland Terminals

In many places around the world bimodal and trimodal inland terminals have become a central part of the transport system, particularly in regions having a high reliance on trade. Transport development is gradually shifting inland after a phase that focused on the development of port terminals and maritime shipping networks. The complexity of modern freight distribution, the increased focus on intermodal and co-modal transport solutions and capacity issues appear to be the main drivers behind a renewed focus on hinterland logistics. While trucking tends to be sufficient in the initial phase of the development of inland freight distribution systems, at some level of activity, diminishing returns such as congestion, energy consumption and empty movements become strong incentives to consider the setting of inland terminals as the next step in regional freight planning. Also the massification of flows in networks, through a concentration of cargo on a limited set of ports of call and associated trunk lines to the hinterland, have created the right conditions for nodes to appear along and at the end of these trunk lines.

The evolution of inland freight distribution can be seen as a cycle in the ongoing developments of containerization and intermodal transportation. The geographical characteristics linked with modal availability, capacity and reliability of regional inland access have an important role to play in shaping this development. As maritime shipping networks and port terminal activities become better integrated, particularly through the symbiotic relationship between maritime shipping and port operations, the focus shifted on inland transportation and the inland terminal as a fundamental component of this strategy. Thus, after a phase that relied on the development of port terminals and maritime shipping networks, the integration of maritime and inland freight distribution systems has favored the setting of inland ports.

Driving Forces

Each inland port remains the outcome of the considerations of a transport geography pertaining to modal availability and efficiency, market function and intensity as well as the regulatory framework and governance. Their emergence underlines some deficiency in conventional inland freight distribution that needed to be mitigated. This mitigation includes:

- **Land value**. Many deep sea terminal facilities have limited land available for expansion. This favors the intensification of activities at the main terminal and the search of lower value locations supporting less intensive freight activities.
- **Capacity and congestion**. Capacity issues appear to be the main driver of inland port development since a system of inland terminals increases the intermodal capacity of inland freight distribution. While trucking tends to be sufficient in the initial phase of the development of inland freight distribution systems, at some level of activity, diminishing returns such as congestion, energy and empty movements become strong incentives to consider the setting of inland terminals as the next step in regional freight planning.
- **Hinterland access**. Inland locations tend to be less serviced by intermodal transportation than coastal regions. Through long distance transport corridors, inland ports confer a higher level of accessibility because of lower distribution costs and improved capacity. These high-capacity inland transport corridors allow ports to penetrate the local hinterland of competing ports and thus to extend their cargo base. In such a setting, the inland port becomes a commercial and trade developments tool that jointly increase imports, exports and intermodal terminal use.
- **Supply chain management**. In addition to standard capacity and accessibility issues in the hinterland, an inland port is a location actively integrated within supply chain management practices, particularly in view of containerization. This takes many forms such as the agglomeration of freight distribution centers, custom clearance, container depots and logistical capabilities. The inland terminal can also become a buffer in supply chains, acting as a temporary warehousing facility often closely connected to the warehouse planning systems of nearby distribution centers. Purchasers can even be advantaged by such a strategy since they are not paying for their orders until the container leaves the terminal, delaying settlement even if the inventory is nearby and available.

The geographical characteristics linked with modal availability and the capacity of regional inland access has an important role to play in shaping the emergence and development of inland ports. Each inland market has its own potential requiring different transport services. Thus, there is **no single strategy** for an inland port in terms of modal preferences as the regional effect

remains fundamental. In developed countries, namely North America and Europe, which tended to be at the receiving end of many containerized supply chains, a number of inland ports have been developed with a focus on inbound logistics.

The setting of global supply chains and the strategy of Pacific Asian countries around the export-oriented paradigm have been powerful forces shaping contemporary freight distribution. Indirectly, this has forced players in the freight transport industry (shipping companies, terminal operators, logistics providers) to examine supply chains as a whole and to identify legs where capacity and reliability were an issue. Once maritime shipping networks and port terminal activities have been better integrated, particularly through the symbiotic relationship between maritime shipping and port operations, inland transportation became the obvious focus and the inland terminal a fundamental component of this strategy. This initially took place in developed countries, namely North America and Europe, which tended to be at the receiving end of many containerized supply chains. The focus has also shifted to considering inland terminals for the early stages of global supply chains (outbound logistics), namely in countries having a marked export-oriented function.

Inland terminals have evolved from simple intermodal locations to their incorporation within logistic zones. Inland terminals (particularly rail) have always been present since they are locations from which specific market coverage is achieved. Containerization has impacted this coverage through the selection of terminals that were servicing a wider market area. This spatial change also came with a functional change as intermodal terminals began to experience a specialization of roles based on their geographical location but also based on their 'location' within supply chains.

Logistical Activities Related to Containerization

The logistical activities that support container transportation fall into four broad categories:

- **Container Management**. Activities related to making the container available to the transportation market. It is particularly concerned with the brokering or the leasing of containers which involves the management of the existing container inventory in view of customers' demands. Also, decisions are made about the segments along possible transport chains the containers will be using.
- **Container Transportation**. All the activities related to the physical movement of containers along transport chains. It concerns maritime shipping, terminal operations and inland transportation.
- **Container Handling**. Activities related to the handling of goods carried in containers, particularly loading, transloading and unloading.
- **Container Storage and Maintenance**. Concerns the pre and post container transportation activities. Empty containers have to be brought

to a terminal or a depot so that that can be inspected for transport worthiness, cleaned and repaired if necessary. Once this is done, they are ready to be reused or repositioned.

"Many of these activities are now taking place at satellite terminals and inland ports".

5. Functions within Transport Chains[4]

A functional and added value hierarchy has emerged for inland terminals. In many instances, freight transport terminals fit within a hierarchy with a functionally integrated inland transport system of gateways and their corridors, where they service three major functions:

- **Satellite terminals**. They tend to be close to a port facility, but mainly at the periphery of its metropolitan area (often less than 100 km), since they mainly assume a service function to the seaport facilities. They accommodate additional traffic and serves functions that either have become too expensive at the port such as warehousing and empty container depots or are less bound to a location near a deep sea quay. A number of satellite terminals only have a transport function transshipping cargo from rail/barge to trucks and vice versa, as is the case for the 'container transferium' concept of the port of Rotterdam or the Gateway Access Point (GAP) concept in Belgium. Satellite terminals can also serve as load centers for local or regional markets, particularly if economic density is high, in which case they form a multi-terminal cluster with the main port they are connected to through regular rail or barge shuttle services. For gateways having a strong import component, a satellite terminal can also serve a significant transloading function where the contents of maritime containers are transloaded into domestic containers or truckloads.

- **Freight distribution clusters (load centers)**. A major intermodal facility - load center - granting access to well defined regional markets that include production and consumption functions. It commonly corresponds to a metropolitan area where a variety of terminals serve concomitantly intermodal, warehousing, distribution and logistics functions. These tend to take place in logistics parks and free trade zones (or foreign trade zones). The inland terminal is thus the point of collection or distribution of a regional market. The more extensive and diversified the market, the more important is the load center. If the load center has a good intermediary location, such as being along a major rail corridor, then freight distribution activities servicing an extended market will be present.

4 www.issuu.com/henleymedia/docs/pti-50 (Accessed June 2011)

- **Transshipment facilities**. Link large systems of freight circulation either through the same mode (e.g. rail-to-rail) or through inter-modalism (rail-to-truck, or even rail-to-barge). In the later case, the inland terminal assumes the role of a load center. The origin or the destination of the freight handled is outside the terminal's market area, a function similar to that of transshipment hubs in maritime shipping networks. Such transshipment terminals are often found near country borders in view of combining administrative processes linked to cross border traffic to value-added logistics activities. Although this function remains marginal in most parts of the world, ongoing developments in inland freight distribution, where the scale and scope of intermodal services are increasing, are indicative that transshipment services are bound to become more prominent.

These functions are **not exclusive**, implying that inland terminals can service several functions at once. Therefore, there is no single model for an inland port. For inbound or outbound freight flows, the inland terminal is the first tier of a functional hierarchy that defines its fundamental (activities it directly services) and extended (activities it indirectly services) hinterlands. Considering the potential mix of the functions of inland ports, five major criteria insure that they fulfill efficiently their role as an interface between global and regional freight distribution systems:

- **Site and situation**. Like any transport facility of significance, an inland port requires an appropriate site with good access to the rail or the barge terminal as well as available land for development. Access to a large population base is of importance since it will be linked to the level of import and export activities handled by the inland port. Transportation remains the most significant logistics cost, underlining the importance of an accessible location. Several inland ports also have an airport in proximity which can help support a variety of freight activities.

Logistic Costs Breakdown

Total logistic costs reveal much about the locational dynamics of logistics activities, particularly distribution centers. Transportation costs remain the dominant consideration as they account for about half of the logistic costs. Inventory carrying costs are also significant with a share of about one fifth of total costs. They include the costs of holding goods in inventory (capital costs, warehousing, depreciation, insurance, taxation, and obsolescence) and are commonly expressed as a share of the inventory value. Labor costs involve the physical handling of goods, including tasks such as packaging and labeling. Customer service encompasses receiving and processing orders from customers.

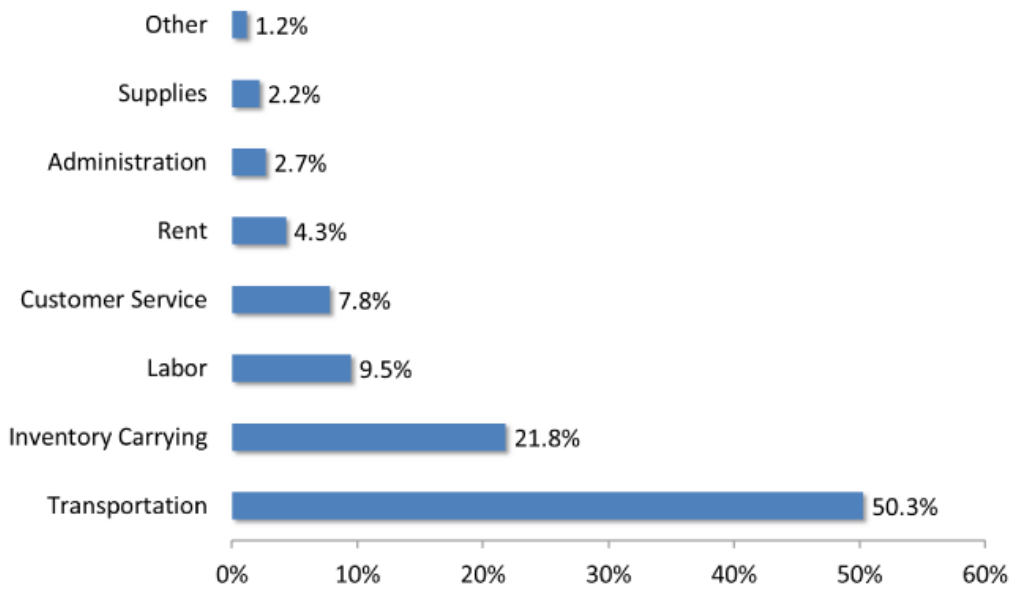

Figure 1: The distribution of the Logistics costs[5]

Under such circumstances, distributors are willing to pay higher rents to take advantage of a logistics site that offers co-location with an intermodal terminal since this strategy enables them to reduce transportation costs, such as drayage, as well as improve their time responsiveness (lead time). Therefore, while transportation costs remains the most important element of logistics costs and its friction, non-spatial components such as inventory carrying and labor costs, are significant components.

- **Repositioning**. Since most long distance trade (and some domestic) is supported by containerization, there are numerous instances where a regional market imports more than it exports (or vice-versa). Under such circumstances, an inland port must provide the physical and logistical capabilities to insure that empty containers are repositioned efficiently to other markets if local cargo cannot be found. This can take the form of empty container depots and arrangements with freight forwarders to have slots available for repositioning.

- **Cargo rotation**. Whether there are imbalances in container flows or not, an inland port must insure that the inbound and outbound flows are reconciled as quickly as possible. A common way involves a cargo rotation from imports activities where containers are emptied to exports activities where containers are filled with goods. For container owners, let them be maritime shipping or leasing companies, a rapid turnover of their assets is fundamental and will secure a continuous usage of the inland port. Effective repositioning and cargo rotations strategies will

5 Establish, Inc. / HWD & Grubb & Ellis Global Logistics.

insure higher revenue levels for both the container owners and the dry port operators.

- **Trade facilitation**. An inland port can also be a fundamental structure promoting both the import and export sectors of a region, particularly for smaller businesses unable to achieve economies of scale on their own. The hinterland massification opportunities offered by inland ports are associated with lower transport costs and a better accessibility. Through these, new market opportunities become possible as both imports and exports are cheaper.

- **Governance**. The way an inland port is owned and operated is indicative of its potential to identify new market opportunities and invest accordingly. In many cases, the commitment of a large private investor such as a port operator or a real estate developer can be perceived as a risk mitigation strategy in addition to provide expertise in the development of facilities and related activities. Sections of an inland port can be shared facilities (e.g. distribution centers) so that smaller players can get involved by renting space and equipment. This also applies to the appropriate strategies related to each stage in the life cycle of an inland terminal from its construction to its maturity where its potential has essentially been taped off. The setting of a Foreign Trade Zone (FTZ) is also an option to be considered.

Operational Advantages of Foreign Trade Zones (FTZ)

A Foreign Trade Zone (FTZ) is an area that is considered outside the customs jurisdiction of a country. It makes possible to import specific categories of goods without going through custom procedures as long as the goods remain within the FTZ. In the FTZ, the goods can be transformed (e.g. assembled, tested, packaged) into other goods and then "exported" out under a different custom category.

Main Governance Models for Inland Ports and Logistic Zones

Inland ports and their associated logistic zones have a wider range of options than ports in terms of their governance model, where the landlord model prevails. The ownership and the management of an inland port can be public, private or a combination of both. Since an inland port is a long term project that is unlikely to be profitable in its initial phase, they represent a high risk for private investors.

- **Custom clearance**. Since the FTZ is a bounded facility, the custom clearance can be done inland instead of at the port of entry and the consignment can stay in the bounded area for an unlimited amount of time. It is likely that this can be done faster inland because the facility is less congested than a large gateway port. The consignee thus gets a

better notice about the availability of his shipment and can plan his supply chain management accordingly.

- **Duties**. In spite of decades of trade liberalization, duties are still levied on international trade. With a FTZ duties are not paid until the consignment is shipped out and can be deferred further if moved to another FTZ. If a transformation (e.g. assembly, labeling, testing) is performed within the FTZ, this added value activity is not subject to duties and can change the duty class of a product to a more preferential level. Commonly, duties are not levied if a product is damaged, defective or obsolete since its commercial value is considerably reduced. Thus, by inspecting products in a FTZ, the duty will be waived for any defective products. This is particularly useful for products that have a higher propensity to be damaged or defective.

- **Settlement**. For most transactions, particularly through letters of credit, the vendor is not paid until the consignment has left a facility (FTZ and/or transport terminal). A FTZ can thus be used to delay settlement until judged suitable by the consignee and also offers the opportunity to readily remove the value of damaged or defective products from the settlement.

6. The Regional Effect and Inland Ports

Regional issues, namely how inland ports interact with their regional markets, remain fundamental as it defines their modal characteristics, their regulatory framework and their commercial opportunities. Depending on the geographical setting and the structure, governance and ownership of inland transport systems, inland terminals have different levels of development and integration with port terminals. They are part of a port regionalization strategy supporting a more extensive hinterland.

7.a Functional Relations between Inland Terminals and their Hinterland[6]

An inland terminal has various levels of integration with its hinterland that depends on the concerned economic activities and each involves a specific array of flows. Succinctly, they can be divided into three tiers:

- **Tier I (Inland terminal)**. Concern all the activities and the flows taking place within the terminal, particularly intermodal movements (rail car to storage area and vice versa) and those related to warehousing and stacking. These flows are very closely integrated since they are linked with terminal efficiency and productivity. However, intermodal terminals require a large amount of space to reconcile the operational

6 http://homes.ieu.edu.tr/~adeveci/bin/Courses/LOG%20450/Slides/Lec%206%20Terminals%20and%20Location.pdf

differences between rail (high volume and low frequency) and trucking (low volume and high frequency).

- **Tier II (Logistics activities)**. Inbound and outbound freight is linked with distribution centers and other freight activities directly related to the terminal such as empty container depots and chassis storage. Logistics activities also involve the management part since these flows must be reconciled with existing demand and transport capabilities in terms of capacity and timely availability. The second tier is thus a managerial apparatus of the physical and information flows related to the inland terminal and functions as a buffer between the terminal and its hinterland (regional economy). It acts as the fundamental hinterland of the terminal. Over this issue, two dynamics are prevalent; one export-oriented and the other import-oriented. Export-oriented logistics are mainly based on consolidation; reconciling commercial flows with load units according to customer's demand and level of service constraints. Import-oriented logistics are mainly based on deconsolidation; reconciling inbound load units with commercial flows. This implies several logistics activities such as assembly, transloading, palletizing, and even postponing deliveries to better answer changes in demand.

- **Tier III (Retailing and manufacturing activities)**. This tier is not linked directly to the terminal, but to its buffer (second tier) and concerns two distinct flow categories. The retailing sector dominantly have inbound flows and as a result creates an array of imbalanced flows that must be managed by the second tier. The manufacturing sector tends to have more balanced flows, particularly for intermediate activities, and generates substantial outbound flows managed by the second tier. It acts as an extended hinterland. On the opposite side of the spectrum, commodities, particularly if they are containerized, generate imbalanced outbound flows. The ideal would be to reconcile the imbalances of inbound container flows with outbound flows.

A **logistics pole** can be defined as the interactions between tier 1 and tier 2 activities, essentially creating a freight buffer for an hinterland. All the three tiers taken together essentially define a **freight region**; the dominant market area of an inland terminal.

7.b Hinterland Setting and Major Economic Regions[7]

The hinterlands of three major economic regions can be synthetically represented in terms of their intensity and the importance of gateways and corridors that service them:

[7] http://homes.ieu.edu.tr/~adeveci/bin/Courses/LOG%20450/Slides/Lec%206%20Terminals%20and%20Location.pdf

- In **North America**, there is a high level of concentration of economic activities along the coastal areas (East and West coasts) with significant resource and manufacturing hinterlands. From coastal gateways long distance rail corridors, often taking the form of a land bridge, are servicing a continental hinterland. This hinterland is articulated by major transportation and industrial hubs such as Chicago.

- In **Western Europe**, the hinterland is the most intense in the interior, notably along the Rhine river system. This hinterland is accessed from coastal gateways, such as Rotterdam, Antwerp, Hamburg and Le Havre, by medium distance corridors involving a variety of combinations of road, barge and rail services. Almost all the major European capitals are interior cities located along rivers.

- In **East and Southeast Asia**, a significant share of the economic activity takes place along the coast, which does not forbid high population density interior hinterlands, such as in China. Hinterland access is commonly problematic, linked to the fact that a large share of the accumulation of new economic activities has taken place in the vicinity of major gateways. There is thus a strong contrast between coastal gateways equipped with modern (container) terminals and hinterland poorly serviced by rail freight services.

Foreland and Hinterland-Based Regionalization[8]

- Regionalization is a process that can take place both of the foreland and the hinterland with the goal to provide continuity between the maritime and inland freight transport systems. The concept of foreland-based regionalization refers to the integration of intermediate hubs in regional shipping networks, where the maritime foreland of the intermediate hub is functionally acting as a hinterland. For reasons like deviation, small volume and niche hinterland, some ports are not that well-connected to the global long distance shipping network and show limited opportunities to improve this connectivity, as shipping companies must consider effective network configurations that tend to focus on major gateways and intermediate hubs.

- Freight flows on the foreland and hinterland are not taking place at the same momentum, particularly since on the foreland economies of scale have been more effectively applied than on the hinterland. In light of an increasing massification of containerized freight loads, and while the ultimate goal remains atomization (individual containers delivered to freight owners), the insertion of an intermediate hub can in some circumstances act as a mitigation strategy. The largest containerships can call at intermediate hubs with high capacity and frequency services.

[8] http://homes.ieu.edu.tr/~adeveci/bin/Courses/LOG%20450/Slides/Lec%206%20Terminals%20and%20Location.pdf

Through feedering, ports serviced through the intermediate hub can have smaller ships (e.g. Panamax class) calling at a high frequency.

- At a regional level, several small or medium-sized ports may realize that it is in their long-term interests to have a higher level of integration with an intermediate hub, even if it comes at the expense of shorter distance pendulum services calls. Foreland-based regionalization can support export-oriented strategies with a better connectivity of more marginal (or in their early stage of growth) ports to global shipping networks and thus international trade. There are also site constraints, environmental factors or simple market potentials that may limit the volumes generated by the hinterlands of some ports. On the intermediate hub side, the volatile long distance transshipment traffic would be complemented with a more stable and secure regional traffic. Both the foreland and the hinterland are mutually self-reinforcing, as hinterland stability can anchor the volatility of the transshipment function, particularly in light of footloose operators.
- A better reconciliation between forelands and hinterlands would help to insure that returns on investments are higher; subject to less fluctuation and improving competitiveness of maritime ranges. This may be a potential outcome of the expansion of the Panama Canal over North American East Coast ports as transshipment activity increases in the Caribbean.

7. Future Prospects

The setting of dry ports (inland ports) have been a dominant paradigm in the development of hinterland transportation as the growth of maritime transportation and its economies of scale have placed pressures on the inland segment of freight distribution. The prospects for inland ports remain positive with large continental markets like North America and Europe relying on a network of satellite terminals and load centers as a fundamental structure to support hinterland freight movements, particularly their massification. This entailed the emergence of extended gates and with them extended forms of supply chain management in which inland terminals play an active role. As congestion increases, inland terminals will be even more important in maintaining efficient commodity chains. It can also be expected that resources will play a greater role within containerized trade with inland terminals, again underlining unique regional characteristics. This implies a set of repositioning strategies where inland terminals play a fundamental role either to improve the efficiency of this repositioning, by providing better cargo rotation opportunities, or by acting as an agent that can help promote containerized exports. Inland ports will take part of the ongoing intermodal integration between ports and their hinterland through long distance rail and barge corridors. They are likely to be more important elements within supply chains,

particularly through their role of buffer where containerized consignments can be cheaply stored, waiting to be forwarded to their final destinations.

Like several stages in intermodal transport development, such as in port infrastructure, there is a potential of overinvestment, duplication and redundancy as many inland locations would like to claim a stake in global value chains. This appears to be the case in Western Europe where an abundance of inland terminals, particularly within the Rhine / Scheldt delta, is indicative of an over competitive environment and the waste of resources it implies. In North America, because of a different ownership and governance structure, the setting of an inland port, at least the intermodal terminal component, is mostly in the hands of rail operators. Each decision thus takes place with much more consideration being placed on market potential as well as the overall impact on their network structure. The decision of a rail company to build a new terminal or to expand existing facilities commonly marks the moment where regional stakeholders, from real estate developers to logistics service providers, readjust their strategies. In some instances, local governments will come with inland port strategies adjusting to existing commercial decisions in the hope to create multiplying effects.

The development of dry ports around the world has clearly underlined an emerging functional relation of port terminals and their hinterland. Based upon their regional setting, dry ports assume a variety of functions with co-location with logistical zones a dominant development paradigm. While the interest in dry ports has increased we have to be aware that no two dry ports are the same. Each dry port is confronted with a local/regional economic, geographical and regulatory setting which not only define the functions taken up by the dry port, but its relations vis-à-vis seaports. Best practices can only be applied successfully if one takes into account the relative uniqueness of each dry port setting.

8. Inland port life cycle: the way ahead

The life cycle approach should focus on the impact that the inland port site activities will have on the highway network. If the result is truck trips enervated from the site, traffic levels will be relatively low when a site is newly opened. As the site develops, traffic will grow at some point in time when there is a thriving transportation system (usually multi-modal), generating a variety of trips that will impact both local and regional highway networks.

Interestingly, the life cycle relationship may also reflect other measures of success that sponsors are seeking, such as employment, profit, and an enhanced tax base. However, this guide focuses on the aspect of traffic.

The general development of the life cycle of an inland port can be described using the following five stages:

Stage	Name	Description
I	Preparation	▪ Evaluation Criteria fulfilled ▪ Proponents begin to attract companies and local support
II	Establishment	▪ Modes established or planned ▪ Anchor tenants arrive
III	Expansion	▪ More sectors begin to locate on site ▪ Planned model investment takes place ▪ Cluster theory materializes
IV	Stabilization	▪ Companies invest in expansion of current facilities ▪ Non-trade services (like housing) established ▪ Slowdown in new arrivals
V	Reduction	▪ Companies begin to leave because of better options elsewhere ▪ New private-sector trends materialize forcing change in operations

Table 1: *Development Life Cycle Stage Descriptions*

9. INLAND PORT CLASSIFICATION METHODOLOGY[9]

In general, there is a lack of consistent understanding of what an inland port is and how it functions. An introduction to the marketing product life cycle concept will then be discussed as it relates to the development life cycle of an inland port. The development life cycle stage will aid transportation planners in determining the level of assistance that is needed for individual inland ports. This assistance can be both in terms of stating the requirements those proponents of an inland port site must meet at each stage and the expected responsibilities of the transportation agency.

Figure 2: is a flowchart that illustrates the steps that are followed in the classification methodology developed in this paper. This flowchart provides a visual explanation of the process.

[9] www.utexas.edu/research/ctr/pdf_reports/4083_1.pdf (Accessed July 2010)

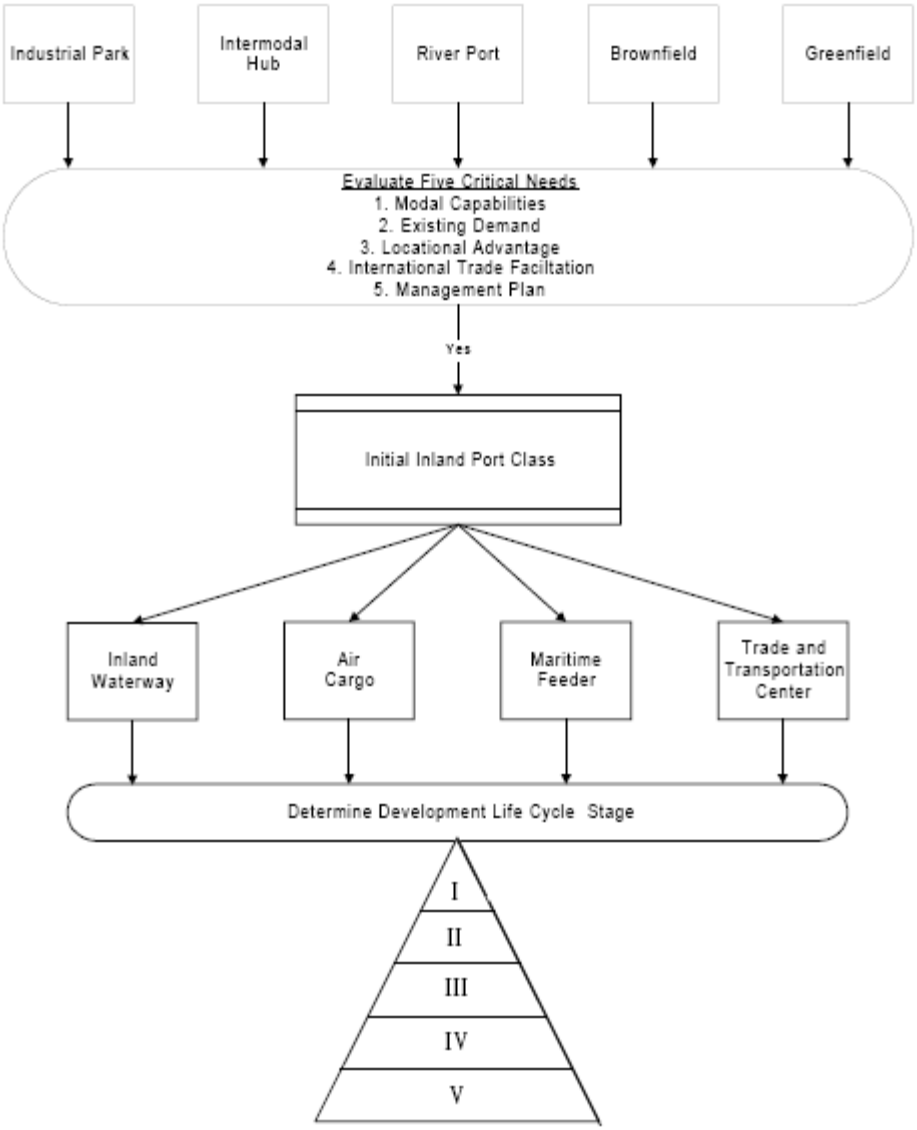

Figure 2: ***Sample Inland Port Classification Methodology Flowchart***

The development life cycle can be viewed both as a planning tool for inland port proponents and an evaluation tool for transportation planners. In their consideration of inland ports, transportation planners will work at each stage to support the site proposal and ensure that the appropriate investment is being made at the state level. The following sections identify the five stages of inland port development and the key elements that are expected from the proponents or supporters of the facility, together with potential responses from the transportation planners.

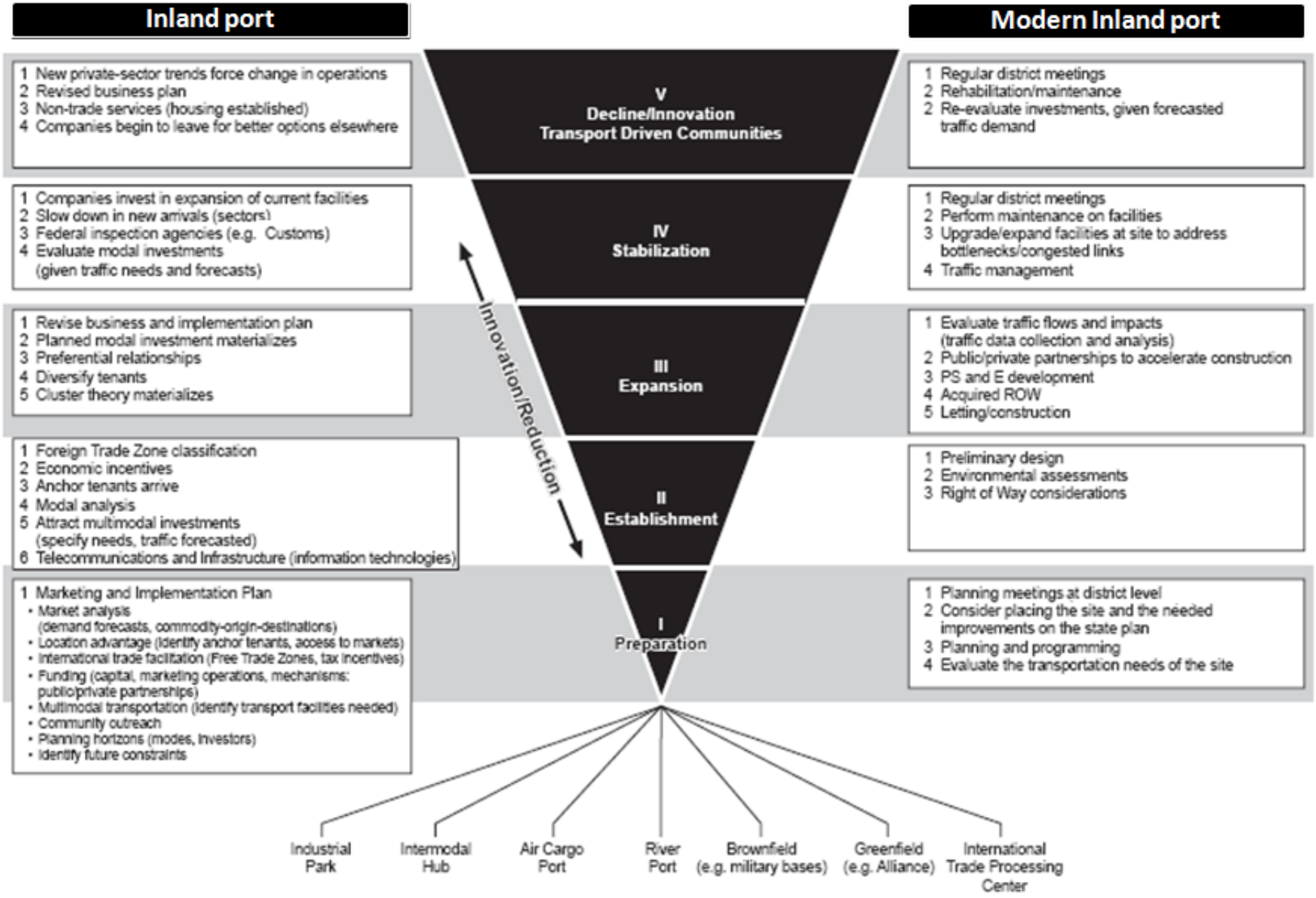

Figure 3: Inland port life cycle (tradition vs. modern)

10.a CRITICAL NEEDS AT AN INLAND PORT

Four classes of inland ports have been identified; each has several elements necessary for success. It is hypothesized that the different inland port classes will make different impacts on corridors. Therefore, this review of inland port critical needs will provide transportation planners with a framework to further discover the impacts inland ports have on creating more efficient supply chains and trade and transportation corridors.

The following literature review details critical needs necessary for successful port operations that have been explored in many published articles and identified by individuals involved in port operations. These needs have been used to identify successful development strategies, location strategies for shippers, and site selection criteria among others. Since the operations of traditional ports are assumed at some inland ports, with added services the critical needs of traditional ports can be adapted to provide a list of critical needs at an inland port.

The following four objectives could also represent the critical needs of small communities considering inland port developments. The four objectives or critical needs are:

- Sufficient demand for intermodal freight transportation
- Local supply of competitive motor carrier service
- Practical basis for successful community relationships
- Adequate public/private-sector capital to fund development

There are some factors directly apply to inland port critical needs because an integral part of a developed inland port is value-added services like manufacturing and distribution. The site selection factors are:

- Physical infrastructure
- Proximity to suppliers and customers
- Political and tax considerations
- International trade considerations

The following checklist is provided to shippers so that the best port based on particular needs can be selected. Fifteen items are included in the checklist; all combined, the list provides the shipper with the total picture when selecting a port. This list provides brief descriptions of each item.

- Location: Closest port geographically or by transit time
- Cost: Actual cost, time, insurance, other legs
- Service: Which shipping lines, railroads, motor carriers service the port
- Reliability: Consistent transit time
- Time: Time cargo takes to move through the actual port facility
- Security: Protection from theft, proper handling
- Labor: Stable environment
- Infrastructure: Highway, rail, other modal access
- Market: Large or small consumer base

- EDI: Paperwork handled electronically
- Customs: Available and adequate
- Equipment: Specialized needs considered
- Facility: Can volume and large vessels be handled
- Environmental Issues: Are there dredging problems
- Foreign-Trade Zone: Does the site have Foreign-Trade Zone designation

This list is very comprehensive and easily identifies a wide range of critical needs. However, this checklist requires modifications, i.e., inland ports do not need dredging but there may be environmental issues, if used to determine critical needs at an inland port.

The following asset list comprehensively describes what a community can concentrate on to develop into an inland port. These assets can be considered the critical needs of an inland port. The following list is the nine assets and a description of each.

- Intermodal transportation capacity: Air, rail, highway, deep water access
- Demographic advantage: Close to large percent of national population
- Geographic advantage: Access to markets
- Presence of shippers: Does demand already exist
- Information technology infrastructure: Is the infrastructure in place
- Public/Private cooperation: Is there an established working relationship
- Councils: Address concerns of interested parties
- Aggressive marketing: Obtains community support and attracts business
- Capable program management: Leadership to move the inland port forward.

10.b The Intelligent Inland port management System

This innovation in the transportation chain together with the operation and documentation complicity will never work except with the support of the new technologies; following is a list which is very comprehensive and easily identifies a wide range of technologies needs. However, this checklist is just a model, while the required inland ports management System do not need dredging but there may be other issues, if used to determine critical IT needs at an inland port.

10.b.1 Components of Intelligent Inland port management System

- Truck entry control system in port area
- Network of dry ports and truck staging areas
- Monitoring and control IT technologies
  - GPS/smart seals, data exchange technologies
- Services to trucks, cargo, and drivers

10.b.2 Services Offered at Truck Staging Areas and inland Ports

- For the cargo

  - check in/dispatch
  - GPS monitoring/control
  - container storage
  - smart seals
  - Consolidation/deconsolidation
  - warehousing
  - customs clearance
- For the trucks
  - truck repair
  - environmental permits
  - sales – tires, fuel, spare parts
  - parking
  - GPS monitoring/control
- For the truck drivers
  - electronic bulletin boards for freight bookings
  - cafeteria
  - food store/pharmacy
  - hotel
  - communications center (internet/phone)
  - dispatch
- For the Shippers
  - Supply chain visibility
- Ancillary services
  - Banking
  - Offices for logistics services – freight forwarding, ships' agents, etc.

10.b.3 Benefits of Integrated Truck Staging Area/Inland Port Approach

- Reduces urban congestion
- Reduces fuel costs
- Reduces pollution
- Reduces equipment capacity requirements
- Increases equipment utilization rates
- Decreases freight costs
- Decreases traffic congestion on freight corridors
- Reduces road maintenance costs
- Enhances security of trucks, cargo, and drivers
- Enhances driving safety
- Reduces insurance costs
- Creates micro economies -- local employment opportunities
- Reduces total logistics costs
- Enhances global competitiveness

SUMMARY

This paper has formulated a definition of an inland port and a classification methodology that can be used to support transportation planning functions related to inland ports. An inland port is a site located away from traditional land, air, and coastal borders containing a set of transportation assets (normally multimodal) and the ability to allow international trade to be processed and altered by value-added services as goods move through the supply chain.

RECOMMENDATIONS

Inland ports may 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. Therefore, future research should focus on determining how an inland port can be evaluated to determine its potential for success and the support that can be provided by transportation agencies.

An evaluation matrix should be created to equitably and consistently determine if a site has fulfilled the five critical needs necessary for initial success. A weighting system may be introduced so that sites that are further along in their development receive higher priority than those in the initial stages. Transportation planners and policy makers can use this matrix when sites petition for support.

Further investigation should be made into the support that transportation planners and policy makers can provide during the five development life cycle stages. Inland port proponents will be interested in knowing what is potentially available and transportation planners need to understand what support is most valuable. A more robust framework will also aid in the equitable and consistent support provided by transportation planners.

Finally, investigation should be made into the locational aspects of inland ports on macro and micro levels. On the macro level, existing trade corridors should be determined and forecasts should be made taking into account potential corridor shifts. Transportation planners evaluating sites can use the identified corridors when considering existing demand in the evaluation matrix.

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