METRICS FOR CARGO-ORIENTED DEVELOPMENT
Measuring the Dynamic Interaction of Community Economic Development &
Freight System Efficiency

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ABSTRACT

Previous studies have shown that freight transportation experts and economic development professionals along with elected representatives look at different metrics when they consider projects that link freight system improvements with sustainable economic development. This paper proposes to establish common ground between these perspectives by framing a set of metrics for Cargo-Oriented Development (COD) – a form of development that sites and retains logistics, distribution, and manufacturing businesses in locations that benefit from access to multiple modes of freight transportation, complimentary industrial businesses, and a ready industrial workforce. The paper also outlines a research agenda through which questions raised by the COD metrics can be resolved and the potential benefits of this form of development clarified.

Keywords: Freight, Manufacturing, Intermodal, Drayage, Economic Development, Metrics
THE INTEGRATED PERSPECTIVE OF CARGO-ORIENTED DEVELOPMENT (COD)

In 2012 the State Smart Transportation Initiative (SSTI) engaged the Center for Neighborhood Technology (CNT) to study metrics used by state departments of transportation and other investors to evaluate the economic impacts of freight transportation investments. CNT is both a practitioner of economic development, working closely with local governments in the execution of their projects, and a research institution that studies numerous aspects of sustainability. A key finding of CNT’s analysis for SSTI is that stakeholders with different roles in the process of freight transportation system improvement and economic development use different criteria for evaluating performance, as depicted in the accompanying diagram. Freight carriers, officials in departments of transportation, and their consultants are primarily concerned with measures of freight throughput, the volume, speed, and reliability of freight movements. Elected representatives, managers of economic development programs, and community leaders want to assess impacts on job creation, local economies, the environment, and the quality of life in neighborhoods. While both of these viewpoints focus on essential concerns, they frequently fail to recognize courses of action that could serve the common interest and realize the full benefits of freight system improvements linked to sustainable economic development (1).

Such findings have led CNT to propose metrics for Cargo-Oriented Development (COD): A form of development that locates and retains logistics, distribution, and manufacturing businesses in locations that benefit from access to multiple modes of freight transportation, complimentary industrial businesses, and a ready industrial workforce. COD builds freight system efficiency while capturing the value of freight investments for local communities. This is particularly relevant to the development of intermodal terminals and its surrounding industries and communities.
Intermodal freight plays an important role in the nation’s freight transportation system. Although studies in intermodal freight abound, similar to the views held by different stakeholders mentioned above, the academic literature is divided, primarily into two groups, focusing respectively on freight system efficiency and local economic development. Existing research in the first group intends to address both system-level issues such as service network design, and individual components in intermodal freight transportation such as drayage, rail haul, and terminal operations. Various methods and tools including GIS-based analysis, interviews, organizational science, econometric modeling, and mathematical programming have been used. References (2, 3, 4, 5, 6) provide comprehensive reviews of existing research.

Compared to the first group, the second group of intermodal freight research is relatively scant. McCalla et al (7) examined eight locations in Canada to study the locality of intermodal freight terminals and industry linkages. In the US, Miller, et. al.(8) explored different job creation factors for inland and near-dock intermodal facilities in terms of facility types, management structures, financing options, and activities performed. From a more generalized standpoint, the local economic impact of establishing an intermodal terminal can be assessed using economic tools such as Input-Output based impact models, land use and development models, computational general equilibrium models, and regional economic simulation models, as is often done for evaluating the economic impact of a transportation project. Weisbrod(9) surveyed existing tools to predict the impact on economic development of transportation projects. Despite these existing studies, no single framework unifies the assessment of the impacts of intermodal development on freight system efficiency, local economic growth and other aspects, such as sustainability. On the other hand, a unified assessment framework is important when jointly planning and developing intermodal terminals with surrounding logistics, distribution, and manufacturing businesses, community, and the economy at large.

Our proposed framework for COD intends to fill this void. The objective of this paper is two-fold. First, we summarize and synthesize our COD study to date by presenting the series of COD metrics we developed, and the rationale of their development and adoption. Second, we outline an agenda for future COD research which highlights four aspects for more in-depth investigation, in order to further understand and capture the value of COD.

I. THE COD METRICS

The following table provides a thumbnail overview of the metrics CNT proposes for assessing the efficiency, economic development potential, environmental and public safety impact of a COD project or area strategy.
A full statement of each metric includes a quantitative standard by which the degree of attainment by this metric be measured. The COD metrics are logically integrated, so that decisions which lead to a favorable rating by one metric will make similar attainments far more likely. These inter-relationships are clarified in the following paragraphs in which the metrics in each topical subset are stated and then briefly discussed.

A. Local Economic Development Metrics

**Statement of the Local Economic Development Metrics**

1. **Industrial Location Efficiency**: The extent to which a COD project site or district (the area within a project boundary) possesses a combination of characteristics:
   a. *Proximity and convenient access to multiple modes of freight transportation*, measured in truck drive time between a project site and access to freight transportation assets, such as terminal gates, expressway ramps, or transload facilities
   b. *Vacant or under-utilized land in an established industrial district*, measured by the acreage of land within a project boundary that was zoned for industrial use prior to the proposal of the project and classified as vacant by the local assessor or found in the property assessment to include no built assets that add more than ten percent to the value of the land
   c. *Convenient access to a large, local industrial workforce, through proximity & public transportation*, measured by the number of working age residents who reside within a thirty minute trip by public transportation to the project site, as determined by CNT’s AllTransit™ analytical tool (10).
   d. *Proximity to concentrations of industrial businesses*, measured by the number of workers within a project boundary who are employed in manufacturing or logistics occupations according to the North American Industrial Classification (NAIC) system.
   e. *Location on a truck route to an expressway that is free of infrastructure obstructions and passes entirely through industrially zoned areas*, measured by the percentage of such a truck route that passes through industrially zoned areas, with the presence of any significant road obstruction, such as a bridge too low for the passage of a conventional heavy truck as a disqualifying factor
   f. *Public sector policies and programs that effectively facilitate industrial location efficiency*, measured by the number of acres within the jurisdiction of the concerned local government that meet the criteria of industrial location efficiency (per metrics 1.a.-e.), and have been converted from vacancy or under-utilization to full productive use -- having at least the average assessed value per square foot as industrial property in the
same jurisdiction.

g. **Index of industrial location efficiency**, a single value for the industrial location efficiency of any site or district location, which is determined by conducting a chi-squared minimization analysis on the locations in the group, based on the data used in the assessments of metrics 1.a.-f.

2. **Accessibility for Manufacturing**: The number of manufacturing plants and workers employed in manufacturing plants, per NAIC classifications, that are adjacent to or within specified short drive times of freight transportation assets that can reduce shipping costs, including intermodal terminals, freight transload and consolidation centers, and active rail lines.

3. **Job Creation & Career Paths**:
   a. **Creation of good jobs**, jobs directly created in logistics or manufacturing businesses that meet or exceed average regional salaries for jobs with comparable educational requirements
   b. **Workers in training and career development programs**, measured by the number of students/workers enrolled in logistics or manufacturing training programs that award nationally recognized skill certifications for logistics or manufacturing jobs.

4. **Worker Public Transit Access**: measured by the percentage of workers in a COD district who commute without driving alone.

5. **Public Costs and Revenues**:
   a. **Road maintenance costs**, which will vary with the number of truck vehicle miles traveled (VMT) relative to the scale of economic activity.
   b. **Size of the tax base**, varying with the level of assessed property value, business development, and income from employment in COD districts.
   c. **Indirect/induced economic development**, encompassing secondary economic impacts of property development, business growth, and job creation in COD districts. These impacts can be projected with IMPLAN or a comparable micro-econometric modeling tool and tracked over time in light of actual development.

**Reasons for Adopting the Local Economic Impact Metrics**

Projects that have basic characteristics of COD and industrial location efficiency -- the location of industrial businesses at places with access to multiple modes of freight transportation, particularly intermodal freight terminals -- have created significant economic and environmental benefits. Projects co-located with new intermodal freight terminals have generated hundreds or thousands of jobs, depending on the planned scope of the project and factors such as involvement of the public sector in planning and development (8,11). The retention and upgrading of existing intermodal terminals has also been shown to be an important factor in industrial job retention (12). The volume of U.S. freight moving by intermodal shipments has more than doubled over the past 25 years, from 5.9 to 13.5 million containers per year (13), and because rail transport is three to seven times more fuel efficient than trucking, this growth has yielded important savings for American businesses and reductions in air pollution (14). Over the last three years railroads alone have invested more than $25 billion per year in upgrading the freight system, and these investments have been dwarfed by the investments of industrial developers, distributors and manufacturing companies building and upgrading plants to gain improved freight transportation access (15,16).
However, some trends in the pattern of freight-linked development undercut the economic and environmental benefits of intermodal growth. New intermodal terminals and adjacent industrial parks are frequently built in exurban greenfields removed from the existing industrially zoned districts and current centers of manufacturing and population. In these exurban locations intermodal facilities serve inter-regional shipping patterns that efficiently distribute finished goods across North America. However, exurban terminals add truck miles to intra-regional drayage, especially to trips that serve manufacturers, which remain concentrated in the industrial districts of cities and inner-ring suburbs of most US metropolitan areas. For example, in some regions exurban terminals are twice as far from the center of manufacturing employment as terminals built in an industrial district of a city or near suburb. The distances to exurban terminals and logistics-industrial parks require long commutes by car for most workers, and pose serious obstacles to employment for aspiring workers from lower income communities in inner cities or first suburbs. Despite these disadvantages, in the absence of effective public sector support for rail-linked development in urban areas, developers and railroads commonly assume that they must choose exurban locations in order to assemble the land required for new intermodal facilities and co-located businesses.

**TABLE 2 Location of Manufacturing Jobs and Intermodal Terminals**

<table>
<thead>
<tr>
<th>Terminal Name</th>
<th>Region</th>
<th>Distances (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP - Global 2</td>
<td>Chicago</td>
<td>19.41</td>
</tr>
<tr>
<td>BNSF - Corwith</td>
<td>Chicago</td>
<td>21.94</td>
</tr>
<tr>
<td>NS - 47th St.</td>
<td>Chicago</td>
<td>23.92</td>
</tr>
<tr>
<td>CN - Harvey/Homewood</td>
<td>Chicago</td>
<td>31.41</td>
</tr>
<tr>
<td>BNSF - CenterPoint Intermodal Center</td>
<td>Chicago</td>
<td>42.64</td>
</tr>
<tr>
<td>UP - New Rochell</td>
<td>Chicago</td>
<td>64.92</td>
</tr>
<tr>
<td>CSX - Buckeye Yard</td>
<td>Columbus</td>
<td>17.72</td>
</tr>
<tr>
<td>NS - Rickenbacker</td>
<td>Columbus</td>
<td>22.46</td>
</tr>
<tr>
<td>CSX - Marysville</td>
<td>Columbus</td>
<td>35.00</td>
</tr>
<tr>
<td>BNSF - Memphis</td>
<td>Memphis</td>
<td>11.37</td>
</tr>
<tr>
<td>CN - Memphis</td>
<td>Memphis</td>
<td>13.93</td>
</tr>
<tr>
<td>CSX - Memphis</td>
<td>Memphis</td>
<td>14.13</td>
</tr>
<tr>
<td>NS - Rossville</td>
<td>Memphis</td>
<td>21.44</td>
</tr>
<tr>
<td>UP - Marion</td>
<td>Memphis</td>
<td>23.96</td>
</tr>
</tbody>
</table>

"Distance" refers to the distance from the intermodal terminal to the geographic center of manufacturing employment in that metropolitan statistical area.
Metrics of Location Efficiency

Several of the COD metrics are designed to measure progress toward a more compact pattern of rail-linked development that enhances benefits for local economies and the environment. Measuring the acreage of previously used vacant industrial land returned to productive use, worker access to job sites via public transportation, and the number of industrial businesses and workers within a project area are steps in this direction. The metric for measuring truck access through industrial areas is one of the safeguards introduced to ensure that compact industrial development does not create negative environmental consequences for urban neighborhoods, along with metrics discussed in regard to Freight System Efficiency and Environmental Impact.

In proposing these metrics CNT recognizes that the public sector must often play an active role in preparing previously used vacant land for redevelopment by facilitating land assembly, remediating brownfields, demolishing antiquated structures, upgrading infrastructure, and providing incentives for the use of green technologies in newly opened business operations. The public sector’s effectiveness in carrying out these activities will be reflected in the number of previously vacant acres in industrial districts restored to productive use.

CNT demonstrated an application of the integrated metrics for industrial location efficiency in a project it undertook with community partners in the southern suburbs of Chicago, an area rich in freight infrastructure with a traditionally extensive industrial base, which has been winnowed by international competitive pressures over the last three decades. CNT conducted a GIS-based survey of the industrial districts in this area and identified over 3,000 acres of vacant industrial land with excellent access to freight infrastructure, industrial business, and a large local workforce that can reach COD sites by public transportation (17). These findings have been the impetus for a strategic redevelopment effort that has thus far generated over $80 million in public and private investments, assessed or remediated more than 500 acres of industrial brownfields, created more than 400 industrial jobs (18).

Access for Manufacturing

Measuring access to freight transportation options that can reduce shipping costs for manufacturers is of particular concern for regional development, the US economy and the intermodal freight system. Manufacturing includes numerous pathways to middle class incomes for workers who are not college graduates and produces exportable wealth that allows a regional economy to grow beyond the scale of its own consumer markets(19). At a national level, America’s recovering manufacturing sector is crucial to federal initiatives to improve the country’s balance of trade. Additional manufacturing business would also enable the intermodal freight system to achieve a more balanced, two-way pattern of product flows that is now heavily tilted toward distributing imported finished goods (20).

Job Creation and Career Paths

The primary benefit of COD for local communities is the number of quality jobs created and the ability of local residents to qualify for these jobs and build careers from them. A first criterion for job quality is the wage paid. Federal data demonstrate that a worker’s earning potential is generally tied to his or her level of educational attainment. A realistic expectation for communities is that wages for jobs directly created in COD will be at national levels for jobs that require a similar level of education. Average jobs in logistics and manufacturing generally meet this test, although entry level jobs that require no particular prior knowledge pay little more than the minimum wage and jobs for workers who acquire technical skills or any level of
management responsibility usually earn well above the average for employees with their level of education (21). A positive feature of both the logistics and manufacturing industries is that the pathways to promotion are generally fluid. Workers can advance by completing training to earn certificates of competence in technical or management skills that are issued by professional trade associations and often taught in community colleges (22). Accordingly, community leaders can monitor and improve the benefits of job development they are achieving through COD by tracking the performance of certified skill training programs. A notable example of an effective worker training program built on the COD initiative in Chicago’s southern suburbs mentioned earlier is the Calumet Green Manufacturing Partnership (CGMP), which coordinates the work of three community colleges and over thirty corporate participants that train workers in certified manufacturing and logistics skills. Over the last two years CGMP has placed more than 150 south suburban residents in skilled manufacturing or logistics jobs.

Worker Public Transit Access

The availability of public transit to an industrial district is a component of industrial location efficiency (Metric A.1.c.). But an additional COD metric measures the percentage of workers who reach employment at an industrial employment center without driving alone, using Census Transportation Planning Product (CTPP) data (23). Measurement by this metric may identify situations in which workers face “last mile” problems in using public transportation and help to plan remedies such as extended transit service, shuttle services, or van pools. Such intensive services are commonly arranged by a Transportation Management Association working with the regional transit provider (24).

Public Costs and Revenues

A significant and readily quantifiable public benefit that follows from COD’s effects in replacing or shortening truck trips is a reduction in road maintenance costs; approximately $3 in road degradation occurs for every 1,000 miles traveled by a heavy truck (15). COD will also enhance revenues in direct and immediately measurable ways including: restoring vacant industrial properties to the tax rolls, retaining existing tax paying businesses while bringing in new businesses to the jurisdiction, and generating new and larger payrolls. Major secondary and induced benefits that flow from these developments may be estimated by econometric models including IMPLAN and REMI. These include rising values of properties near redeveloped sites, purchases by new businesses and employees and the secondary impacts of additional wealth circulating in the community, gradual reductions in tax rates as the tax base is broadened, and the attraction of further business and household investment to a prospering area in a virtuous cycle of redevelopment.

B. Freight System Efficiency

Statement of the Freight System Efficiency Metrics

1. Truck Mileage Efficiency, measured as fuel consumption per ton-mile, by truck compared to other freight transportation modes

2. Efficiencies in the Intermodal Drayage and Terminal Operations:
   a. Truck Vehicle Miles Traveled (VMT) in intermodal drayage
   b. Efficiencies in intermodal terminal operations measured by: (1) the fuel consumed and (2) space in the terminal footprint required for each container moved through an intermodal terminal
3. **Travel Time & Reliability**
   a. **Travel Time** measured by: (1) Planned shipping period to ensure on-time delivery and (2) Actual time elapsed in shipment
   b. **Reliability**: measured as the percentage of freight shipments completed at the time promised to the shipper

4. **Right-Sized Shipping** measured by savings in shipping costs realized through a combination of applied information technology and industrial location efficiency

5. **Total Direct Costs of Shipment**: measured as the sum of costs charged to a shipper for all stages of a shipment

**Reasons for Adopting the Freight System Efficiency Metrics**

Trucking will always be an essential component of freight transportation in America. However, on a per ton-mile basis, moving freight by truck generates three to seven times more shipping costs, fuel consumption, air pollution, and accidents than shipping by rail (25). Despite these disadvantages, trucking is the sole mode of transport selected for most shipments because it is usually faster and offers more reliable on-time delivery than rail. Accordingly, truck mileage has been growing at a pace with the US economy and the logistics business sector in particular, as the nation has emerged from the Great Recession. During the same years, a steady trend towards urbanization and cultural change among younger Americans has led to a flattening and gradual decline in car mileage driven. Consequently, truck mileage is the nation’s most rapidly growing source of traffic congestion and air pollution from mobile sources (26).

Intermodal shipping is competitive with truck-only movements in time and reliability and the nation’s most promising option for moving substantial amounts of freight by a cheaper, more sustainable, and safer mode. However, drayage and terminal operations at the first and last legs of an intermodal shipment may consume up to 27% of rail’s cost and environmental benefits; so intermodal freight’s competitiveness – and market share – depends on short drayage and the efficiency of terminal operations. Development in the compact patterns of COD establishes short truck drays and rewards investment in state-of-the-art truck, rail, and intermodal terminal technologies that minimize fuel consumption, and pollution. By reducing the key constraints of drayage and terminal operating costs, COD builds the market for intermodal freight, including business from manufacturers which can add to balanced, two-way intermodal cargo flows.
Manufacturers, particularly smaller firms, may contribute to reductions in truck mileage and their freight transportation costs through *right-sized shipping* — the use of one or more of a range of options that become available when the advantages of a COD district location are leveraged with continuously improving information technology:

- Within COD districts more manufacturers may be able to follow a traditional path to reduced freight costs through carload service to plants clustered along active rail lines. For example, the industrial development and freight transportation firm OmniTRAX, builds rail-served industrial parks, acquiring a short line rail connection to a Class I railroad and developing the park with sufficient density of manufacturers to make both the industrial park and the rail operation viable (27).

- Districts densely settled with manufacturers will be in a favorable position to support transload services, which breakdown rail carload shipments to a number of customers, making the economies of rail transportation available to companies that are not located on an active rail spur. For example, the City of Davenport, Iowa, used a grant from the federal Economic Development Administration to build a multi-purpose, rail transload center as a key amenity of an industrial park (28).

- Smaller manufacturers frequently rely on “less-than-truck-load (LTL)” services, which are 3 to 4 times more expensive than full truck or container load rates. Prospects to lower LTL rates lie in the extreme competitiveness of this industry, which includes FedEx and UPS along with national trucking companies and third party logistics (3PL) firms. LTL carriers

![Diagram of Fuel Savings (Truck vs. Intermodal)](source: US DOT National Transportation Statistics, ICF International)
operate freight consolidation centers to which their customers’ cargoes are drayed and organized into full truck loads. Smaller LTL competitors mine information and identify concentrations in the sectoral and geographic clustering of potential customers to find market opportunities. For example, the 3PL firm Kane is Able worked with Sun-Maid Raisins and other California food producers to establish direct purchasing agreements with major retailers that include load consolidation arrangements for the producers’ shipments (29).

- Creativity in load consolidation is not limited to reducing LTL costs. In widely reported example, Dial Tile, a manufacturer of floor tiles in Mexico, was concerned that its heavy products reached maximum weight limits for containers and box cars while leaving substantial volume empty in the shipping cubes. Over several years Dial Tile worked with 3PLs and freight carriers to establish load sharing partnerships to carry its products with lighter manufactured goods in configurations that optimized the volume and weight capacities of containers, trucks, and boxcars (30).

While efforts to reduce the total cost of manufactured products through right size shipping usually arise from applications of information technology, they necessarily involve a geographic, physical component. At some point the possibilities identified through data analysis need to turn into actual movements of products in real time and space. To the extent that the industrial districts of metropolitan areas are built in location efficient COD patterns, more opportunities for efficient cargo load consolidation and distribution are likely to be feasible in that region.

C. Environmental Impact Metrics

Statement of the Environmental Impact Metrics

1. *Air Quality Metrics: Presence of three representative pollutants* – particulate matter, nitrogen dioxide, and CO₂ equivalents – estimated as a function of diesel fuel burned

2.-4. *Sustainable Freight Terminal Design* – rain water management, noise level, light management – estimated as a function of adherence to design standards of the Leadership in Energy and Environmental Design (LEED) organization

5. *Regional Land Use* measured by:
   a. The number of jobs per acre created or retained in location-efficient COD districts and
   b. The number of industrial jobs and acres developed in COD districts as a percentage of all industrial jobs and acres developed in the region.

Reasons for Adopting the Environmental Impact Metrics

Reductions in truck mileage, including drayage, along with the application of the most efficient freight technologies will reduce diesel fuel consumption and so multiple forms of air pollution in ways that have been extensively studied. Accordingly air pollution may be reliably modeled from known fuel use. Some forms of water and soil pollution which are caused by the settling of air-borne pollutants may also be minimized and modeled as a function of fuel use. Additional negative environmental impacts that commonly result from freight movement and industrial activity include storm water, noise, and light pollution. When state-of-the-art technologies and industrial designs are applied to the mitigation of these problems and the impacts are measured
by COD metrics, the results can be transformative:

- Truck routes to major freight facilities, such as intermodal terminals, pass entirely through industrial areas.
- Trucks are admitted to terminals in seconds via automated gate systems, now in common use, which read digital codes, eliminating truck queues.
- Implementing technology from the Mi-Jack Corporation, trucks entering terminals discharge and receive containers from automated stations, without the use of cranes. A wall of these stations holds the containers in a rack structure several containers high for loading onto or from intermodal trains. Multiple movements of containers within the terminal are eliminated, so the required footprint is 60% to 80% smaller than conventional terminals today (31).
- In advanced grounded terminals, such as the BNSF facility in Memphis, containers are lifted between stacks and trains by overhead, fully electric cranes, which consume no fuel on site and operate virtually without noise (32).
- Also in BNSF Memphis terminal lighting is directional, illuminating work areas with negligible spillage to surrounding properties.
- Terminal grounds are designed to hold rain water in place (33).
- In its overall design and buildings, the terminal conforms to LEED standards (34).

Terminals built and operating in these ways are cleaner, greener, quieter, and smaller than today’s standard intermodal terminal. Yet all of the elements of such terminals are now in operation in US intermodal facilities.

D. Safety Metrics

Statement of the Safety Metrics

1. Accident & Injury Rate, measured by comparison with national and local historical rates of accidental injuries and fatalities
   a. National data reported per billion tons of freight moved by rail and truck
   b. Existing historical regional rates

2. Safety Assurance – Achieved by strict compliance with federal and local regulatory standards for each mode
   b. Railroad adherence to the guidance of the Federal Railroad Administration’s “Risk Reduction Program”

Reasons for Adopting the Safety Metrics

Safety is an overarching concern of public agencies that regulate freight transportation, freight carriers, and communities that contain freight facilities and infrastructure. Accordingly, safety measures have been and continue to be deeply studied, and regulatory agencies provide guidance to ensure safety. The COD metrics are based on acceptance of this body of work.
II. COD RESEARCH AGENDA

The proposed COD metric system presents just a beginning of understanding the true benefits of implementing COD in the US urban areas. In the future we plan to extend the existing research in four directions as described below.

1. Further investigation of mode shift resulting from COD development.

Our results show that shipping cost reduction at the national level presents significant benefits from COD. The estimates, however, are based on first-order assumptions and can be fine-tuned using more detailed modeling techniques to predict freight mode shift. One likely avenue is to estimate or use existing mode choice models, which are often based on random utility theories. Using them the diversion of freight volume from trucking to intermodal transport can be more accurately predicted for each COD market area.

A key input to the freight mode choice models is shipping cost, and successful implementation of COD hinges largely on the extent of shipping cost reduction. For intermodal transportation, shipping cost contains line-haul rail shipping cost and truck drayage cost. Future research should investigate how both of these cost components can be reduced to make intermodal shipping even more attractive. While railroads charge standard rates for intermodal containers, opportunities exist to reduce line-haul shipping expenses by smart consolidation of items, as in the examples of right-sized shipping noted earlier. Such consolidation leads to more efficient use of container carrying space, reducing the number of containers required and rail shipping cost.

The attractiveness of COD also depends on efficient local truck drayage. Further research should seek a better understanding of drayage charging structures and routing patterns. For example, if a trucking company adopts a coarse zone-based pricing scheme, it charges the same price for delivering to a location 15 miles or 1 mile from the intermodal terminal. Such a zone rate system does not provide an incentive for the shippers/consignees to locate a business closer to an intermodal terminal within the same region. In our future investigation will collect and synthesize data on existing drayage charging structures, including the impact of new technologies for tracking truck movements. Based on the findings of this research alternative pricing schemes that are more distance-based may be considered. Trucking companies will benefit from incentivizing their customers to locate in close proximity to an intermodal terminal: shorter trip distance will mean more truck trips in a day, thus greater utilization of capital assets (i.e., trucks) and higher revenue. The routing of drayage can also be improved through consolidation of commodities from different shippers, presenting another scenario through which small manufacturers may benefit from right-sized shipping. To this end, our research will examine the state-of-the-practice in commodity consolidation/transloading and explore potential ways to improve loading factors in truck drayage via better business practice and technology innovations.

2. Better methodologies to quantify the local economic impact of COD.

The COD metrics for local economic development call for tracking the amount of vacant land in existing industrial districts that is returned to productive use and the direct job creation and tax
base growth that results from such redevelopment. Future research will take a more systematic approach that will estimate direct and indirect impacts (e.g., agglomeration effects), of transportation-related expenditures at the regional and local levels. Regional Input-Output models, for example, RIMS II IMPLAN, and REMI, would be particularly suitable for this purpose. Such simulation models combine the major elements in large-scale macroeconomic computable general equilibrium (CGE) models, and are capable of providing estimated impacts of COD on local economic growth from changes in labor supply, capital stock, factor cost and productivity.


COD links promotion of intermodal freight transportation with local economic growth and sustainability. Investment in establishing an intermodal terminal is often initiated by private firms, i.e., the railroads and/or industrial development companies. However, as shown in this paper considerable benefits will be reaped by local communities, interstate commerce, and the backbone of the national freight transportation system at large. The public sector should take active steps to facilitate the development of these privately driven CODs and offer further incentives at both planning and implementation stages. This includes providing adequate public funds and forming public-private partnerships between local, regional, and federal governments and the private investors. Policy measures are equally important, such as provision of favorable land use and zoning plans, accommodation of COD in Comprehensive Economic Development Strategies (CEDS) Plans, Long Range Transportation Plans at the MPO level, State Freight Plans, and adoption of objectives in federal policies that are consistent with COD metrics.

Non-profit organizations and academia can also play a useful role by conducting research and disseminating findings to help policy makers and the general public better understand the COD benefits and best ways to implement COD. CNT has been providing this type of research and implementation assistance in the cities of Chicago, Memphis, and New Orleans through initiating collaborations between public and private sectors. In the future CNT will continue seeking dialog with railroads, trucking firms, and industrial developers about alternatives in terminal and industrial park development. Topics of discussion will include the interests of host communities and the environment, linked to business goals of introducing balance in the two-way flow of intermodal cargos and expanding the potential market area for intermodal shipping to include shorter trips. CNT will also work together with universities to study a broader set of metropolitan areas and regions that have intermodal presence and some COD characteristics, identifying and comparing factors that lead to more successful COD. The new research is expected to provide additional evidence and policy recommendations for further COD planning and implementations.


In the present study we consider a number of metrics to quantify COD benefits from the perspectives of local economic development, freight system efficiency, environmental impact, and safety improvement. A further goal is to develop a unified metric and a single value that assists industry and government decision makers in making sound COD development decisions. This metric should also be flexible so that decision makers can use it for different regions where priorities and preferences may differ. Once such a metric is built, it will help local governments determine optimal locations for COD investments, along with programs that will best facilitate
COD in their regions. At the national level, the unified metric would help to prioritize COD in candidate cities, subject to budget and other resource constraints. Multi-criteria analysis tools will be developed and implemented when constructing such an ultimate metric. Examples of such tools include multi-attribute utility models, linear additive models, analytical hierarchy process, and fuzzy multi-criteria analysis.

REFERENCES

23. Home site of the Census Transportation Planning Products (CTPP) program http://ctpp.transportation.org/Pages/default.aspx