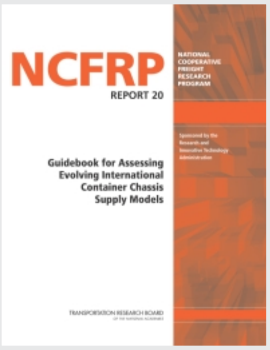

Guidebook for Assessing Evolving International Container Chassis Supply Models

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NATIONAL COOPERATIVE FREIGHT RESEARCH PROGRAM

NCFRP REPORT 20

Guidebook for Assessing Evolving International Container Chassis Supply Models

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This Guidebook would not have been possible without the significant contribution of many study participants and contributors.

The research team recognizes the significant time and input of the more than 80 stakeholders consulted for this study, particularly Consolidated Chassis Management, SSA Terminals, Flexi-Van, Direct ChassisLink Inc., and Virginia Intermodal Terminals for their contributions to the case studies.

The team also gives a special thanks to China International Marine Containers Group Ltd. (CIMC) for their extensive contributions to the international research component of this Guidebook.

Lastly, the research team wishes to thank the Transportation Research Board for the opportunity to undertake this important and timely research project.

FOREWORD

By William C. Rogers
Staff Officer
Transportation Research Board

NCFRP Report 20: Guidebook for Assessing Evolving International Container Chassis Supply Models describes the historical and evolving models of international container chassis ownership and management in the United States. It is intended to provide stakeholders, including beneficial cargo owners, public policy makers and planners, trucking companies, ocean carriers, and terminal operators with an understanding of the most salient issues and implications as the chassis supply market continues to evolve so they can make informed decisions going forward.

The United States is unique in that international container chassis have conventionally been provided primarily by ocean carriers and, to a lesser degree, leasing companies, railroads, motor carriers, and other entities. For ocean carriers, it is a non-revenue-generating service. The global recession in 2009 resulted in large ocean carrier losses and ocean carriers were forced to look for ways to reduce costs. Concurrently, in December 2008, the Federal Motor Carrier Safety Administration (FMCSA) released new requirements that made Intermodal Equipment Providers (IEPs) subject to FMCSA regulation. As a result of these new safety-focused chassis roadability rules, IEPs are required to establish a systematic inspection, repair, and maintenance program. These regulations and the ocean carrier chassis divestiture strategies are spurring new approaches to international chassis supply and management in the United States.

Under NCFRP Project 43, CPCS Transcom Limited was asked to (1) describe the functions and uses of international container chassis in freight movement and the factors driving chassis supply model changes; (2) identify and describe the current chassis supply models by region and terminal operating mode used in the United States; (3) identify and describe the stakeholders and how they influence and/or are affected by each chassis supply model; (4) identify and quantify the positive and negative aspects of each chassis supply model for each stakeholder; (5) enumerate the cost elements and drivers for each element of the various chassis supply models and identify the key metrics to measure the performance of each chassis supply model; (6) describe methods to improve the implementation and operation of each chassis supply model; and (7) develop a matrix that guides each stakeholder through the evaluation of the various chassis supply models.

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Summary

International ocean container chassis supply, ownership, and management in the United States (U.S.) are in transition. Ocean carriers have historically supplied, owned, and managed ocean container chassis in the U.S., unlike every other region of the world where chassis are supplied largely by motor carriers. Due to a number of external and internal factors, including a desire to cut costs, increasing liability relating to chassis, and a greater focus on their core competencies, ocean carriers are now exiting the chassis business. This is forcing the provision, responsibility, and cost of chassis supply, ownership, and management onto other supply chain stakeholders. Thus, new and different ocean container chassis supply models are emerging in response to this shift. However, a great deal of uncertainty remains about these evolving chassis supply models and their implications throughout the intermodal stakeholder constituency. The evolving chassis supply landscape in the U.S. has resulted in a patchwork of different models, which vary by region and terminal. Adding to the complexity, each chassis stakeholder group—from shippers to carriers and terminal operators to public officials—has different interests and concerns with respect to chassis supply and varying levels of understanding of the implications of evolving chassis supply models.

The Transportation Research Board (TRB) as part of its National Cooperative Freight Research Program (NCFRP) initiated this *Guidebook for Assessing Evolving International Container Chassis Supply Models* (under NCFRP Project 43). This research effort was developed between October 2011 and April 2012, largely through consultations and primary data analysis, including a review of secondary research. Over 80 supply chain stakeholders were consulted, including ocean carriers, motor carriers, shippers, terminal operators, railroads, chassis leasing companies, public policy and planning agencies, and labor unions—in short, the full range of supply chain stakeholders with an interest, direct or otherwise, in evolving U.S. chassis supply. The purpose of this Guidebook is to inform chassis stakeholders, including shippers and public officials, about the conventional and evolving models of international container chassis supply in the U.S., and the factors unique to each model, in order to inform their decision making vis-à-vis chassis supply transitions. The findings in the Guidebook were subject to a broad external validation process.

Ocean Container Chassis 101

Ocean container chassis in the U.S. are generally designed to accommodate specific container sizes (40′, 20′, 45′) and have two axles; they are typically lighter than chassis in other countries, given lower U.S. national gross vehicle weight standards. Most ocean container chassis cannot accommodate 53′ domestic intermodal containers. The latter largely serve the rail-based intermodal container transportation market.

Source: CPCS

There are over 700,000 chassis in the U.S, of which close to 80% are standard ocean container chassis. The balance are domestic intermodal chassis. As a ratio to loaded containers, the U.S. operates considerably more chassis than most comparable overseas jurisdictions. This is largely the result of the conventional ocean carrier supply model in the U.S. in which chassis asset optimization has historically not been a priority for the ocean carriers that have supplied chassis.

Terminal operating models can have important implications for chassis management. The terminal storage function can be "grounded," which requires stacking containers, or "wheeled" with containers stored on chassis. Wheeled operations, most typical in inland rail terminals, usually transfer containers to draymen with one lift, but require a larger fleet of chassis and more land to store bare chassis and containers on chassis. Conventionally, ocean container chassis in the U.S. have been stored (parked, stacked, or racked) and managed within the terminal gate. However, because of the need for additional acreage to increase container capacity, chassis are also sometimes stored outside the terminal gate.

The chassis plays a critical role in supply chains and is involved in all first/last mile ocean container truck moves. Conventionally, ocean container drayage in the U.S. has typically been arranged by drayage firms which provide company drivers and also sub-contract service to truck owner-operators to move containers to/from shippers or receivers. The chassis also has a storage function, largely unique to the U.S. At "wheeled" terminals, containers are staged on a chassis until ready for pickup. Chassis are also often left at shippers' facilities for container loading/unloading ("drop and hook" operation), a practice uncommon outside the U.S. These are contributing factors to the relatively larger chassis fleet in the U.S. compared to most international markets.

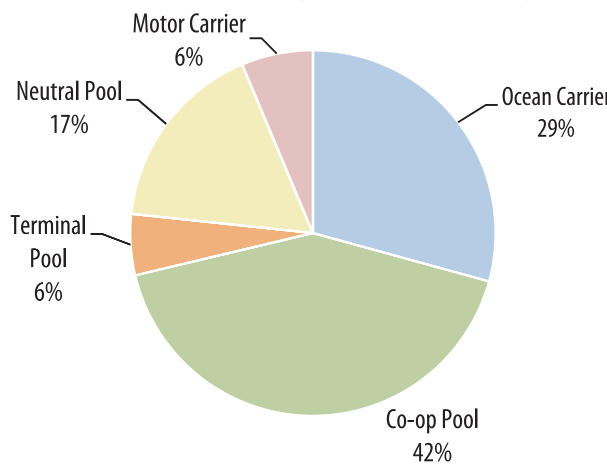
The age and safety of chassis are becoming a matter of public welfare. Approximately 40% of the international chassis were built before 1997. The Federal Motor Carrier Safety Administration's "roadability" rule was introduced in 2005 and became effective on June 17, 2009. These regulations made chassis providers subject to the Federal Motor Carrier Safety Regulations for the first time, and established shared safety responsibility among intermodal equipment providers, motor carriers, and drivers.

Chassis Supply Models

The conventional chassis supply model in the U.S. is one in which the chassis are owned (or leased), operated, managed, and maintained by ocean carriers. In this model, chassis charges are imbedded in the shipping rate as part of the service delivery. There are four alternative chassis supply models in the U.S.:

- **Regional Cooperative (Co-op) and Vessel-Sharing Alliance Co-op Chassis Pools Supply Model:** Chassis fleets are shared between member contributors, who have the responsibility to manage or delegate the management of the operation. Ocean carrier co-op chassis pools were largely established to minimize chassis mismatches and balance requirements, to improve chassis utilization, and reduce terminal storage space requirements. The largest example of such a co-op pool in the U.S. is Consolidated Chassis Management (CCM).

Ocean Container Chassis Supply Market in the U.S., by Model



Source: Adapted from IANA, on the basis of team research.

- **Neutral Chassis Pools Supply Model:** Chassis are provided and operated by a third party (typically a chassis leasing company), independent of ocean carriers and motor carriers, and users are charged a per diem rental rate. An example of this chassis supply model is Flexi-Van's Bay Area Chassis Pool, which supplies chassis to ocean carriers and motor carriers.

- **Terminal Chassis Pools Supply Model**: Several marine terminals control their own chassis pools to better manage and integrate the chassis operation as part of the entire terminal process. The terminal may provide the chassis (like a neutral pool) or just manage them (like a co-op pool). The introduction of marine terminal–controlled chassis pools was largely the result of marine terminal land capacity constraints; pools helped reduce the chassis storage footprint at these terminals, thereby easing capacity issues, and provided a more controlled chassis environment to maximize terminal efficiency.

- **Motor Carrier or Logistics Company Owned (or Leased) Chassis Supply Model:** This model is the international standard, although not well-established in the U.S. given the conventional ocean container chassis supply. Chassis owned by motor carriers in the U.S. are predominantly specialized (e.g., tri-axle) chassis used for the carriage of heavy cargo.

With the exception of the motor carrier chassis supply model, all others are effectively unique to the U.S.

There is a growing trend for ocean carriers working with third parties to invoice motor carriers for chassis usage charges in any of the supply models (except when they supply their own)

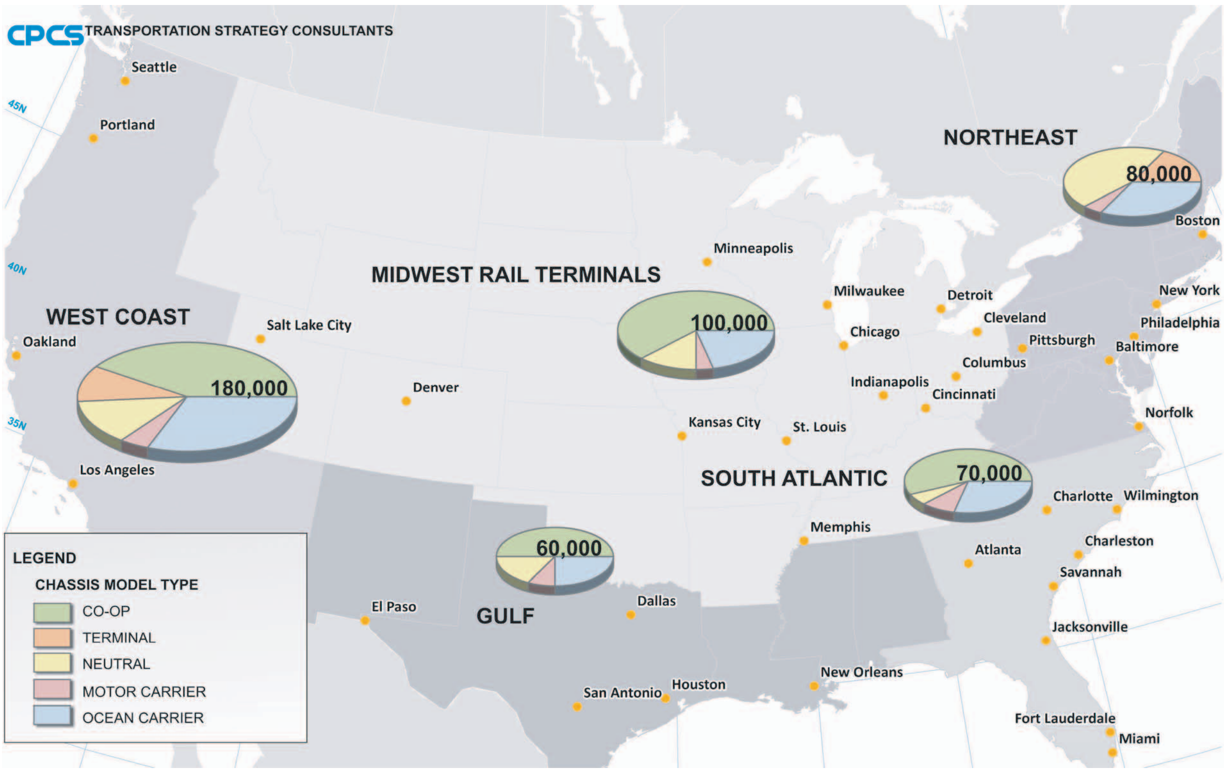
Summary of Chassis Supply Models and Their Characteristics

	(Conventional) Ocean Carrier Chassis Model	Cooperative (Co-op) and Alliance Co-op Chassis Pools Supply Model	Neutral Chassis Pools Supply Model	Terminal Chassis Pools Supply Model	Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Supply Model
Asset Ownership	Owned or triple-net leased by ocean carriers.	Owned or triple-net leased by ocean carriers. Other entities (e.g., leasing companies) that own chassis may contribute to the pool.	Owned by third party (typically a chassis leasing company).	Ocean carriers, terminal, or leasing company may contribute.	Owned or triple-net term leased by motor carrier.
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by ocean carrier.	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by professional management company, with contributing ocean carrier board oversight.	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by neutral chassis pool operator, typically leasing company.	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by terminal operator.	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by motor carrier.
Facilities Agreement	Storage, inspection, and maintenance and repair usually contained within rail or marine terminal master transportation agreement.	Separate facilities (also known as "hosting") agreement necessary for storage, inspection, and maintenance and repair rules.	Stand-alone agreement for storage, inspection, and maintenance and repair rules.	None, since terminal operator controls both terminal and pool.	N/A — Motor carrier chassis stored off terminal.
Typical Measures and Metrics Used by Chassis Operators	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Asset utilization. • Street turn-time. • Out-of-service percentage.	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Utilization: total pool, contributor, user, street turn-time, terminal dwell (dwell same as neutral pool).	• Revenue rate per day. • Utilization: total pool, individual user. • Maintenance and repair cost per day. • Street turn-time. • Terminal dwell. • Out-of-service percentage.	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Utilization: total pool, contributor, user, street turn-time, terminal dwell (dwell same as neutral pool).	• Operating cost per day. • Capital cost per day.

Regional Differences in Chassis Supply Models in the U.S.

The prevalence of different chassis supply models, and the size of related chassis fleets, differs greatly by region. The U.S. chassis supply landscape is heterogeneous and has been evolving in response to different regional influences and operational characteristics. Nevertheless, all chassis supply models are in play in each region, albeit to varying degrees.

The following figure provides an overview of the regional distribution of active ocean container chassis in the U.S., by type of chassis supply model (chassis that are laid up or otherwise not in use are not included). Figures include inland rail terminals insofar as they utilize marine container chassis, which is predominantly the case in the Midwest as only rail terminals are represented in this region.



Source: CPCS estimate and mapping of various data sources collected by the research team, including through consultations with industry stakeholders

Stakeholder Perspectives on Alternative Chassis Supply Models

The wide range of supply chain stakeholders with a direct or indirect interest in chassis supply includes BCOs, ocean carriers, motor carriers, terminals (marine and inland rail), public agencies and planning organizations including port authorities, chassis leasing companies, and unions responsible for chassis maintenance and repair. Each of these stakeholder groups has distinct interests vis-à-vis chassis supply and movement. Likewise, each stakeholder group has different performance needs, expectations, and measures with respect to chassis supply and supply chain performance. Often, these interests and performance needs are distinctly unaligned. For instance, BCOs expect deliveries to arrive on time and do not distinguish between containers and chassis, but in any case tend to prefer a perennial supply of chassis to minimize any transit delay resulting from chassis-related service failures. This is also the case for most motor carriers that want to increase driver productivity, maximize driver turn times, and minimize delays in sourcing chassis. On the other hand, marine and rail terminal operators want to minimize the amount of chassis needed within the terminal to support container operations, as chassis tie up capital, and can be a poor use of scarce terminal capacity. Public agencies and planning organizations are particularly interested in land-use, traffic and environmental implications, among others, whereas chassis leasing companies tend to be focused on maximizing a return on the chassis assets that they own and manage. For this reason, the perceived advantages and disadvantages of alternative chassis supply models differ by stakeholder, as in many cases do their respective preferred chassis supply model.

Beneficial Cargo Owners: Historically, chassis supply matters have only been of concern to BCOs when chassis shortages or service problems affected their supply chains. With respect to evolving chassis supply models, the BCOs consulted indicated that they are concerned the most about avoiding chassis-caused service failures (i.e., a delay to the cargo transportation plan). They also want to maintain current chassis terms of delivery and chassis supply operations, including drop and hook and free time at their facility. From a cost standpoint, the evolving chassis supply landscape is particularly salient with respect to merchant haulage as this may require BCOs to arrange and pay for their own chassis, when they did not previously. In every case, BCOs preferred the status quo to any emerging alternative chassis supply models, which is not surprising given the specific BCO interests and their current chassis supply arrangements—minimum or otherwise understood service risk, good service terms, generally at no separate explicit cost, no chassis-related capital and operating costs, and so forth. BCOs expressed concern over changes in invoicing and operational impacts, which may be caused by a change in chassis supply models.

Ocean Carriers: Conventionally, most ocean carriers considered providing chassis a cost of doing business in the U.S., although they have had differing attitudes towards chassis ownership, which led to different operating models. Some have historically preferred ownership of assets and operating control while others preferred the flexibility of leasing assets and utilizing neutral chassis pools to avoid the long-term commitment of ownership. Today, most ocean carriers are serious about exiting the chassis supply business and are at various stages of doing so, as exemplified by no new chassis purchases in recent years, transitions to pool models, and the recent sale of the Maersk chassis business to a private third party. Key considerations and interests with respect to evolving chassis supply models are minimizing capital and operating costs and ensuring an adequacy of supply (chassis in the right place at the right time), among other issues. Major challenges to transitioning to alternative models include the disposition of owned assets and commercial considerations vis-à-vis the shipper community, which tends to resist a departure from the status quo.

Motor Carriers: The economics of the marine drayage business is based on maximizing the number of truck trips daily, since drayage rates, and driver compensation, are move-based. The motor carrier industry is highly sensitive to any operational or commercial factors that cause idle time while the driver is working within his/her hours of service schedule. Turns (trips) per day and minimizing terminal dwell time were the two most important productivity measurements listed in the motor carrier survey responses. For the most part, the commercial needs and interests of motor carriers vis-à-vis chassis are in relation to the potential impact of chassis supply on motor carrier productivity. Roadability and equipment failure are also increasing concerns for motor carriers. Chassis-related factors influencing productivity include whether chassis are stored on the terminal or off the terminal, whether the terminal operation is wheeled or grounded, inspection, and over-the-road repair, among others. Not surprisingly, from a motor carrier perspective, the "gray" chassis pools (not specific to individual ocean carriers) were perceived as a big efficiency improvement over the traditional ocean carrier-controlled model due to the flexibility to drop off chassis at more terminals covered by the pool, as well as the big decrease in chassis flips caused by terminal mismatches of containers and chassis. Nevertheless, approximately 85% of the motor carriers surveyed are still unsure of their chassis strategies or are passively awaiting the market to sort it out. Concerns with motor carrier chassis supply are mostly operational and include the need for chassis flips at wheeled terminals, equipment age, quality and maintenance, capital and operating costs associated with chassis, and chassis storage requirements and associated costs.

Terminal Operators: Apart from the cases of terminal-operated chassis pools, terminal operators are less inclined to be concerned with chassis utilization rates so much as cost control and supply liquidity. Terminals have an interest in keeping chassis managed properly to avoid shortages or delays that hurt all users, but all the while never having too great a surplus of chassis occupying limited real estate. Most terminal operators consulted prefer the motor carrier owned-operated model, which would effectively move chassis storage off-terminal. None of those surveyed believed a significant transition to chassis supplied by motor carriers was realistic in the short term, as the barriers to wholesale change are too numerous and too high to undo the current chassis structure. These factors have been described previously, but include the many challenges in the transfer of assets from ocean to motor carriers (capital, storage facilities, maintenance, and administration), the conversion from wheeled to grounded terminal operations, commercial free time, and drop and hook delivery logistics.

Source: Prime Focus LLC.

Implications for Public Policy and Planning Organizations

According to their different authorities, public agencies are responsible for building and maintaining the intermodal connections to state and interstate highway networks. They have responsibility for land use, zoning, and environmental impediments as well as for responding to local concerns about congestion, road repair, and safety. Federal agencies have far-reaching regulatory control over public safety and the use of the nation's highways.

However from an operational perspective, public agencies have limited direct influence over how chassis supply models will evolve—this will largely be determined commercially among supply chain actors.

Nevertheless, the implications are of consequence to public policy and planning organizations. The implications of evolving chassis models could include the potential for increased truck movements on roads to reposition, pick up, or drop off chassis, greater pressures on intermodal connectors, and increased land-footprint requirements for storage, among other issues. Other potential impacts within the purview of the public transportation oversight community are a host of externalities, including road congestion, pollution, road safety issues, and land-use challenges.

A number of chassis supply scenarios could lead to increased truck moves, either bobtail moves (tractor without chassis), or bare chassis moves (chassis without container). Chassis storage practices, in particular, could influence truck moves and related land-use implications. Conventionally in the U.S., chassis have, for the most part, been stored at the terminal sites. Certain chassis supply models do involve, or could lead to, increased off-terminal storage, which could impose new or changed pressures on land use both on and off terminal sites.

Public agencies will have different approaches to handling chassis depending on the nature of their involvement and the number of chassis in their respective regions. Since the transition to new chassis models could affect regional traffic flows and land use, public officials and planning organizations may benefit from the following:

- Developing an inventory of chassis support facilities, equipment depots, and truck parking needs and facilities within their region and keeping track of related traffic flows.
- Identifying how changes in the chassis models will affect truck traffic volume and congestion impacts on local roads and regional intermodal connectors.
- Reviewing land-use and zoning plans, particularly around intermodal terminals to address or mitigate any emerging issues resulting from changes in chassis supply practices.
- Engaging with public- and private-sector chassis stakeholders, including port authorities, to stay informed of prevalent models in their region and of which organizations are influencing change.
- Encouraging private-sector participation in public planning efforts, particularly with respect to the mitigation of negative externalities such as congestion.

In short, public agencies and planning agencies should stay informed of any chassis-related developments in their respective regions, as chassis supply markets are bound to continue to change in the short/medium term.

Conclusions

The U.S. ocean container chassis supply market, which has differed from other regions around the world, is in a state of flux. As ocean carriers seek to exit the chassis supply business and the U.S. chassis environment continues to evolve, the emerging question is: *What will be the future form(s) of chassis supply in the U.S., and what are the implications for chassis supply stakeholders?*

The answer to this question is unclear but the future of chassis supply in the U.S. is likely to be guided in large part by the same factors that shaped its recent evolution:

- **The structural chassis supply context:** Established BCO logistics practices, including the drop and hook chassis operations, chassis pool arrangements, and wheeled terminal operations are some of the factors that preclude a rapid and wholesale change to chassis supply and management practices.
- **The heterogeneous nature of the chassis supply landscape:** Terminal operators, motor carriers, and other stakeholder groups such as unions have a geographic jurisdiction, and, as such, chassis model transitions will likely be forged in a manner that accommodates the commercial and operating practices of regional stakeholders.
- **Multiple and often unaligned interests of chassis supply stakeholders:** Ocean carriers, motor carriers, BCOs, terminal operators, chassis leasing companies, unions, and public policy organizations, among others are all key stakeholders in chassis supply. Their individual perspectives, interests, and performance goals with respect to chassis supply differ, as do their perceived advantages and disadvantages of alternative chassis supply models.

Because each stakeholder group is significantly invested in the current chassis supply models—either financially or operationally—no one faction will likely control or singlehandedly influence the direction of the chassis supply transition in the U.S. Rather, the future evolution of U.S. chassis supply will be the result of the interplay of various stakeholder interests, influences, and regional differences within the structural chassis supply context that shaped the nation's current chassis supply landscape.

Nevertheless, on the basis of consultations with stakeholders across the ocean container supply chains, chassis models in the U.S. will likely continue to evolve toward pooling in the short- to medium-term as stakeholders generally agree the supply from pools in one form or another is more efficient. The perceived benefit of pooling includes increased chassis management efficiencies, utilization and adequacy/balance of supply, decreased risks of chassis-caused service failures and related delays to BCO cargo transportation plans, and a reduced on-terminal chassis storage footprint relative to the traditional individual ocean container chassis supply model.

Whatever the outcome and the pace of the transition, public policy and planning organizations should be aware of the evolving chassis supply models in the U.S. given potential implications for the public. In particular, increased truck moves/miles and land-use initiatives could result by moving chassis storage away from marine and rail terminals, where the majority of the ocean container chassis are staged today. Changes in chassis storage patterns may have a significant impact on local congestion, traffic volume, and land use.

Time will tell what the longer-term implications of the evolving U.S. chassis supply environment will be. In the meantime, it would be in the interest of all chassis supply stakeholders to understand the broad implications of the evolving chassis supply environment—both from the perspectives of their own stakeholder group as well as that of others—and the implications for broader U.S. ocean container supply chains. This Guidebook is intended to go some way in doing this, although it is recognized that more research will be required, and at the regional level, as chassis models evolve to promote a fuller understanding of the resulting implications for U.S. ocean container supply chains and public interest.

"It may take 10 years to sort it out. I support all arrangements, but whoever does it most efficiently will eventually take over, and the market will settle and we will make do in the meantime." – Ocean carrier executive

Introduction

Ocean container chassis supply, ownership, and management in the United States are in a state of transition unlike at any other time in the more than 50-year history of container shipping. Conventionally in the U.S., ocean carriers have supplied, owned, and incurred the responsibility for managing ocean container chassis. This is unlike other regions of the world where chassis are supplied largely by motor carriers and logistics companies.

Due to a number of external and internal factors, including a desire to cut costs, increasing liability relating to chassis, and a greater focus on their core competencies, ocean carriers are now beginning to dismantle the 50-year status quo of supplying, owning, and managing chassis in the U.S., forcing the responsibility and cost of chassis supply, ownership, and management onto other U.S. supply chain stakeholders. By necessity, new and differing ocean container chassis models are emerging in response to this shift. But a great deal of uncertainty remains about evolving chassis supply models and their implications throughout the intermodal stakeholder constituency. The evolving chassis supply landscape in the U.S. is also resulting in a patchwork of different models and regional disparities, adding to the complexity of the transition process.

Moreover, each chassis stakeholder group—from beneficial cargo owners (BCOs) to carriers and terminal operators to public officials—has different interests and concerns with respect to chassis supply and varying levels of understanding of the implications of evolving chassis supply models.

This Guidebook, produced under NCFRP Project 43, is intended to inform chassis stakeholders including BCOs and public officials about alternative container chassis supply, ownership, and management models in a clear and structured way, including the advantages, disadvantages, and key considerations of alternative models, as relevant to the interests of each key stakeholder group. Given the complexities of chassis supply in the U.S., this Guidebook seeks to provide a simplified view of the most salient issues. It is not intended to be comprehensive or address every nuance within U.S. chassis supply markets. Also, the purpose of this Guidebook is not to recommend chassis supply model(s) or manufacturers, but to help chassis stakeholders in the U.S. make well-informed decisions regarding the planning and execution of their own chassis supply transitions.

Note to Readers

This Guidebook was developed between November 2011 and May 2012 using a range of information sources, including, but not limited to, previous research and literature on chassis matters and truck drayage in the U.S. and internationally, a variety of chassis data and supply chain information from public and private sources, consultations with over 80 chassis supply stakeholders in the U.S. and abroad, and the expertise and experience of team members. Appropriate references have been included; stakeholder input has for the most part not been attributed for reasons of commercial sensitivity or stated preference. The CPCS Team does not warrant the accuracy of information or data provided by third parties, although best efforts were made to use information from credible sources.

The findings in this Guidebook were also subject to a broad external validation process.

1 Ocean Container Chassis 101

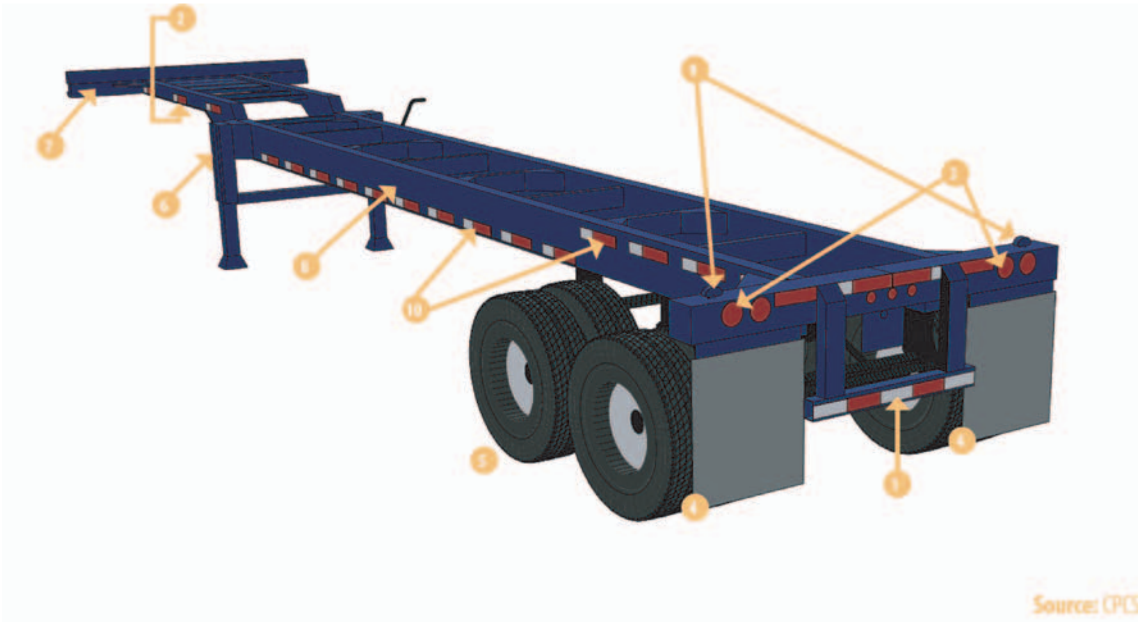
Key Messages

- **Ocean container chassis in the United States (U.S.) are generally designed to specific container sizes (mostly 40′ and 20′) and have two axles;** they are typically lighter than chassis in other countries given lower U.S. national gross vehicle weight standards. Most ocean container chassis cannot accommodate 53′ domestic intermodal containers.
- **The chassis plays a critical role in supply chains and is involved in all first/last mile ocean container truck moves. The chassis also has a storage function, largely unique to the U.S.** At "wheeled" terminals, primarily inland rail terminals, containers are staged on a chassis until ready for pickup. Chassis are also often left at shippers' facilities for container loading/unloading ("drop and hook" operation), a practice uncommon outside the U.S.
- **There are over 700,000 chassis in the U.S., of which close to 80% are standard ocean container chassis.** As a ratio to loaded containers, the U.S. operates considerably more chassis than comparable overseas jurisdictions.
- **Conventionally, chassis in the U.S. have been supplied and operated independently by ocean carriers as part of their service delivery.** Drayage is typically arranged by drayage firms that sub-contract owner operators. This is changing and new models have been emerging (chassis pools). Internationally, chassis are typically provided by motor carriers and stay connected with the truck.

1.1 What Is an Ocean Container Chassis?

An ocean container chassis is a wheeled structure designed to carry marine containers for the purpose of truck movement between terminals and shipping facilities. It is a simple electromechanical device composed of a steel frame, tires, brakes and a lighting system. Figure 1-1 provides an overview of the basic component of a typical chassis.

Figure 1-1. Typical 40′ Ocean Container Chassis



- **Bumper**
- **Coupling pin (kingpin):** After the tractor is backed under the kingpin, the landing gear is lowered to couple the chassis to the fifth wheel of the tractor.
- **Lamps:** Primarily incandescent bulbs; more expensive (but much longer life) LED lighting is becoming more prevalent to reduce bulb-changing delays.
- **Mud Flaps:** Required safety device to protect trailing motorists.
- **Tires:** Four per axle, bias or radial. Tires are the number one maintenance and repair problem; radials last around three times longer.
- **Landing gear:** Support legs and crank handle (not pictured) to drop them.
- **Front and rear bolster:** Device fitted onto a chassis to hold the container. The strength of the front bolster usually is the limiting factor on the number that can be stacked.
- **I-beam (aka "mainframe"):** Steel strength and weight of the rails varies in construction; the heavier the frame, the more durable and longer lifecycle.
- **Twist locks:** Locked into place to secure the container to the chassis. Twist locks can be non-retractable or retractable – the securing head retracts below deck level.
- **Conspicuity tape:** Reflective tape required under NHTSA and FMCSA regulations to improve the visibility of the chassis under low-light conditions.

Not pictured:

Ownership Decals

Axles: Double or triple (considered specialized equipment for heavy-weight cargo). Axles are the heaviest component, thus, a third axle better reduces the weight of the load on a per axle basis to comply with U.S. bridge laws; however, the extra axle increases tare weight and thus reduces the maximum loadable freight weight.

Suspension: Leaf springs or airbag.

Air brake system: Required under NHTSA and FMCSA regulations, air brake chambers are located in different locations on different brands in relation to the axles, which can result in damage during stacking; air lines are also prone to damage from stacking.

[1] Intermodal chassis are the last remaining major users of bias-ply tires, mainly because of the lower initial purchase cost and the very severe service conditions.

1.1.1 Types of Ocean Container Chassis in the U.S.

There are different types of ocean container chassis. The key differentiators are whether the chassis length is fixed or can be adjusted, whether multiple container configurations can be accommodated, and the number of axles.

Ocean container chassis in the U.S. are generally built specifically to support specific container sizes and have fixed sizes; the U.S. size ratio of 20-foot to 40-foot to 45-foot chassis nearly equals the container size ratio in the U.S. trade, approximately 25:65:10.

> By contrast, standard ocean container chassis outside the U.S. typically have retractable "pins" in order to carry multiple container sizes, thereby negating the need to build different-size chassis to match the container length.

U.S. ocean container chassis are generally lighter than other countries' chassis because the U.S. has a national gross vehicle weight (GVW) standard of 80,000 lbs. on Interstate highways, which is lower than most other nations (more than 20% lower in some instances). However, states' truck size and weight laws vary and are often determined by maximum axle weight configurations. Accordingly, in order to maximize cargo weight carried in ocean containers originated and destined to the U.S. (which are also drayed on Interstate roads), ocean container chassis supplied by ocean carriers are built as lightly as possible. A typical ocean carrier-supplied container chassis in the U.S. has two axles, as represented in Figure 1-1.

Heavier container shipments over the regulated weight limit require heavier duty, tri-axle container chassis, and permitting above the standard GVW allowance (Figure 1-2). Because tri-axle chassis contribute to increased weight and asset cost, they are less common in the U.S. (less than 5% of the estimated U.S. chassis fleet) and are often supplied by motor carriers specializing in handling heavier cargo, rather than ocean carriers.

Figure 1- 2. 40' Tri-Axle Chassis

Source: Cheetah Chassis.

1.1.2 Notable Differences Between Ocean Container Chassis and Domestic 53' Intermodal Container Chassis

The "domestic intermodal container," or simply "domestic container" as commonly referred to in the U.S., is a container filled with freight moving between North American terminals via railroad and does not move by waterborne service. These containers are longer than ocean containers, with the standard being 53 feet, and built to a lighter tare weight standard to accommodate more product.

The construction of the ocean and domestic container chassis is essentially the same in the U.S., with notable differences being length and weight. Due to its increased length, a 53-foot chassis weighs between 500 and 700 lbs. more than an ocean container chassis, which weighs approximately 6,500 lbs. Additionally, nearly all 53-foot domestic chassis have a "slider" mechanism which enables the chassis axle bogie to be moved forward or backward and alter the weight distribution and turning radius when traveling on local roads (Figure 1-3).

Figure 1-3. Example 53' Slider Chassis

Source: Cheetah Chassis

As the standard fixed 40′ ocean container chassis is not long enough to support the 53′ domestic container, ocean container and domestic container chassis are generally not interchangeable.[1]

Another notable difference between ocean container and domestic container chassis is the expected operating life of the chassis. If properly maintained, an ocean container chassis' useful life may be 20-plus years (excluding a major refurbishment) while a 53′ chassis' expected life is roughly 15 years, as the latter is generally built to the lightest, and thus least-durable, specification. This trade-off was made to allow domestic intermodal containers to compete directly with 53′ domestic trucks for domestic commerce.

[1] 40′ to 53′ slider chassis do exist in the U.S. but these are not common because they are heavier and there is not a lot of demand for 53′ container chassis among ocean carriers.

1.2 U.S. Chassis Fleet and Ownership

Today, it is estimated there are 725,000 chassis in the U.S., of which close to 80%, or 565,000, are ocean container chassis (of which some 490,000 are active); the fleet of intermodal container chassis is much smaller and estimated to be in the order of 160,000 units.

Ownership of the U.S. chassis fleet is changing with the progressive exit of ocean carriers from the business of chassis supply and the emergence of new models. A current snapshot of chassis ownership in the U.S. is provided both for ocean container chassis, as well as 53' intermodal container chassis (Figures 1-4 and 1-5).

Figure 1-4. Ocean Container Chassis Ownership

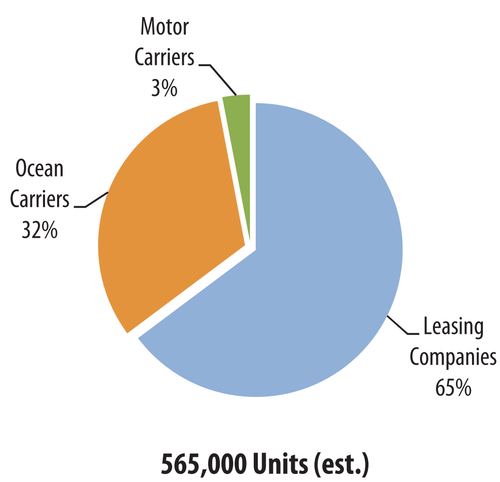
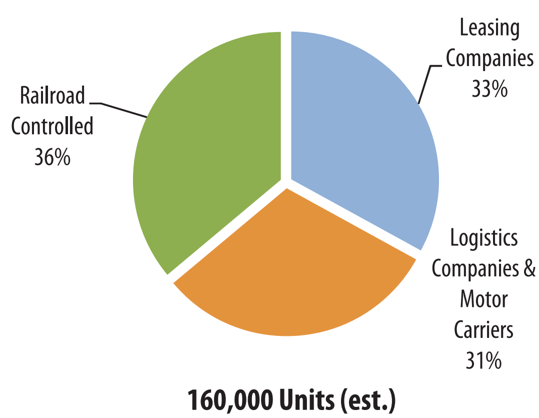


Figure 1-5. Domestic Container Chassis Ownership



Source: IANA and estimates based on consultation.

Figure 1-4 reflects the segmentation of the ocean container chassis market in the U.S.; however, it does not reflect its true fragmentation. Over 20 ocean carriers own or operate chassis, either independently or through various chassis pool structures. The majority of the chassis are domiciled at the port facilities, but up to one-third are located at rail ramps or container/chassis yards. The chassis leasing companies play a stronger role in supplying the marine market compared to the domestic market. Of note with respect to the percentage of ocean container chassis owned by leasing companies in Figure 1-4, this reflects the recent sale of the Maersk chassis fleet to a private investment company, thereby shifting the related chassis count from ocean carrier to leasing company.

Figure 1-5 illustrates the domestic container chassis environment in the U.S. where there are only seven Class I railroads and a handful of large asset-owning logistics companies supporting the entire domestic container intermodal program. Of those, only two railroads operate their own chassis fleet—the Union Pacific Railroad and the Norfolk Southern Railway. Those that do not operate their own chassis rely on the TRAC Intermodal domestic chassis pool. Together, the railroads and TRAC control the majority of the domestic chassis operation in the U.S., while a few large logistics companies, most notably J.B. Hunt and Pacer, control the rest.

At this time, the domestic chassis operation in the U.S. is well established and relatively stable, compared with the ocean container chassis market, which is the focus of this Guidebook.

Internationally, chassis fleets appear relatively smaller than those in the U.S. There is no centralized source of data on global or regional chassis fleets, but the research team was able to develop estimates of the chassis fleets in certain markets, including in Asia (China[2], Japan, Hong Kong[3]), through consultation with the largest manufacturer of containers and chassis, China Intermodal Marine Containers (Group) Ltd. (CIMC).

The total U.S. chassis supply is roughly five times that of China, and likely more than twice the combined supply of East Asia, this despite the latter's container throughput being significantly larger than that in the U.S.

A possible explanatory factor behind the lower supply of chassis in Asia concerns drayage distances and the nature of economic activities. The export-oriented economic development model has favored the setting of factories close to marine terminal facilities. Drayage distances are relatively short and containers are loaded/unloaded immediately, with the tractor remaining hooked to the chassis and the driver waiting until ready for a next move. The utilization level of chassis assets is therefore higher.

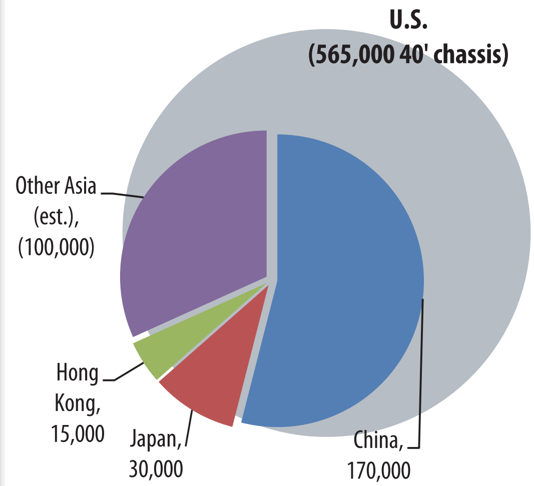
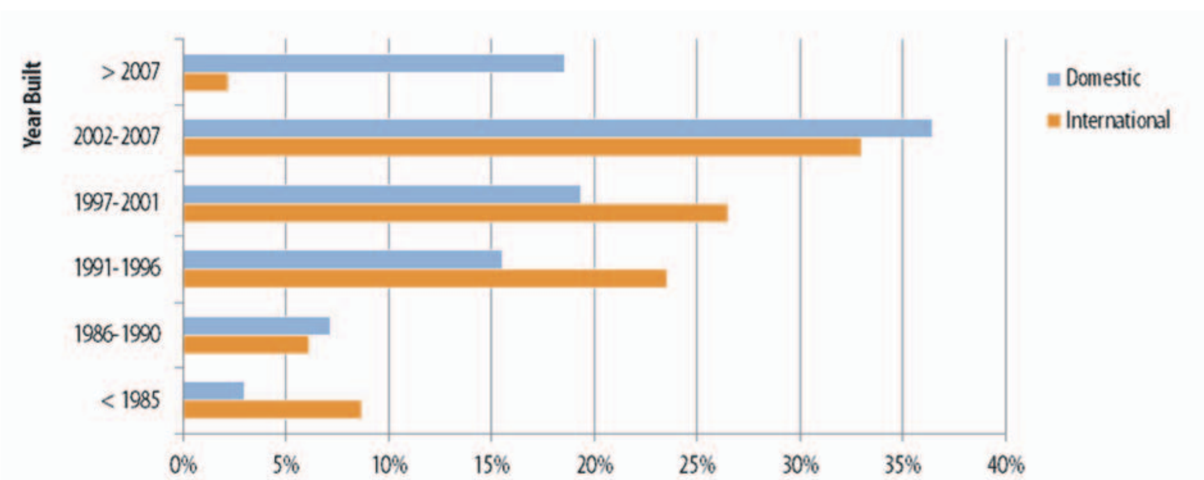


Figure 1-6. Asian Ocean Chassis Fleet

Chassis Age

The U.S. ocean container chassis fleet is aging. As it stands, roughly 40% of international chassis in the U.S. were built before 1997 and are over 15 years old, as represented in Figure 1-7 below. The international container chassis fleet (orange) is much older, on average, than the domestic container chassis fleet (blue). This is due in large part to the recent or planned exit of ocean carriers from the chassis supply business. The consequences of the aging ocean container chassis fleet are many, and include increased risk of equipment failure, safety, and roadability problems, as well as increased liability for those supplying and using the chassis.

Figure 1-7. Age of International Container Chassis and Domestic Chassis in the U.S.



Source: Adapted from Noel, V., Transportation Research Forum, March 2012.

[2] Based on CIMC's estimate of total chassis market sales of 190k units 2005–2011, adjusted for average Chinese chassis life of 5 to 6 years.
[3] Registered chassis in Hong Kong.

1.2.1 Chassis Leasing in the U.S.

Chassis leasing companies own an estimated 350,000 marine units, close to two-thirds of the total U.S. market, and much higher market share than any other global region. Chassis leasing has enabled ocean carriers to avoid related capital investments and to have access to a ready supply of chassis to meet seasonal and unexpected demand.

The most popular leasing product is the long-term operating lease, for which the ocean carrier commits to a fixed volume of chassis for a 3- to 5-year period, and is responsible for maintenance, insurance, and taxes (known as a "triple-net lease"). A variation is the "master lease" for which a lessee commits to maintain a minimum amount of chassis on-hire, at a triple-net lease rate, but is allowed to pick up more units at that same rate, and also may return units, down to the minimum on-hire amount, as demand fluctuates. A third type of triple-net lease is the "direct finance" lease, which is akin to a car lease. The lessee pays a daily rate that includes asset amortization so that at the end of the lease period (typically 7 or 10 years), the lessee may purchase the chassis for a bargain price. The direct finance lease is really a variation of purchase financing, and represents less than 10% of the leasing company portfolio.

The ocean carriers have used different approaches to chassis investment; some carriers preferred to own a majority, some leased a high percentage, and some took a balanced approach between ownership and lease. Historically, about 80% of leasing companies' assets have been under long-term lease arrangements, though that percentage has declined recently as ocean carriers are less willing to commit to long-term leases.

1.3 The U.S. Chassis Supply Environment and Relevant International Differences

The U.S. ocean container chassis supply market is the product of a number of historic and structural factors. These are described below, as they will continue to influence the evolution of U.S. chassis models going forward. As and where relevant, international comparisons with Canada, Europe, and Asia are provided to contrast the U.S. experience and related chassis supply implications.

1.3.1 Ownership Structure

The U.S. is the only region where the vast majority of ocean container chassis are owned by ocean carriers and leasing companies. Currently, motor carriers own only a very small percentage of chassis in the U.S., and these are often limited to heavier duty tri-axle chassis, principally because ocean carriers have traditionally shouldered the responsibility of supplying typical marine container chassis. Additionally, the U.S. is the only region where ownership and operation are not necessarily one and the same. In fact, over 70% of the active ocean container chassis are operated in chassis pools and controlled by third-party managers.

> In Canada, Europe, and Asia, chassis are supplied primarily by motor carriers, logistics companies/3PLs, and to a lesser extent leasing companies through long-term leases to trucking operators. In these markets, motor carriers operate the truck and chassis as a single, unattached asset. In certain jurisdictions, including in Europe, terminals also own their own fleet of chassis; these chassis are used for internal terminal operations only and are not roadworthy.

1.3.2 Road Weight Limitations and Chassis Specifications

In the U.S., the maximum GVW is 80,000 lbs. for the Interstate highway system, which is generally lower than in other parts of the world (see sidebar).

The effect of the U.S. having a lower GVW than other countries is that the standard U.S. marine chassis—a two-axle chassis sized to its container length—is significantly lighter than its foreign counterpart.

There are no overweight permits granted for the federal highway system, but states have the option to grant such permits for intrastate carriage. Some states allow the intrastate up to 100,000 lbs. for non-dividable loads.

> The maximum authorized vehicle weight in the European Union, for example, is 40 metric tons (88,000 lbs.) for articulated vehicles with a two- to three-axle semitrailer, and 44 metric tons (97,000 lbs.) for motor vehicles with a two- to three-axle semitrailer. In China, the gross vehicle weight limitation—including truck, cargo, and trailing equipment—is 49 kilotons, roughly equivalent to 100,000 lbs. In other Asian countries, the weight limitations are similar. Also, in foreign countries that have higher GVW limitation, heavier cargo requires a heavier, sturdier chassis for safe conveyance. That's why the standard foreign chassis is up to 40% heavier and with an additional axle.

1.3.3 Commercial (Bill of Lading) Terms

About half of U.S. container cargo is delivered/originated under carrier haulage, and half as merchant haulage (see box for distinction). The commercial Bill of Lading terms are relevant to the ocean carrier chassis model transition strategy because in carrier haulage, the ocean carrier is responsible for the first/final leg of transport, and thus is responsible for providing a chassis for that movement, either directly or through sub-contract. As most ocean carriers today either own or have committed to long-term lease chassis, it is more economical to provide these "sunk cost" chassis in a carrier haulage move than to pay for an additional chassis (through the drayage rate, or directly from a

> The term "carrier haulage" is used when the drayage of a container, and by extension chassis supply, is arranged by and under the control of the ocean carrier. The term "merchant haulage," in contrast, is used when the BCO arranges the drayage move with its preferred motor carrier, which must source, in one way or another, a chassis for the related move.

chassis leasing company) in the open market. In merchant haulage, the responsibility for transportation of the container stops at the origin/destination terminal, either rail or marine.

By way of contrast, in Canada and Europe, the majority of ocean containers are carried gate to gate (merchant haulage) and either gate to ocean terminal gate for local (truck) delivery or inland rail terminal gate in the case of railed containers. In parts of Asia including China, Hong Kong and Japan, on the other hand, carrier haulage can be much more common, between 70% and 75%, although in other Asian countries, including Vietnam and Thailand, merchant haulage is more typical. Given the differing commercial term models in Asia, and the consistent prevalence of motor carrier-supplied chassis in any case, *this suggests that merchants vs. carrier haulage is not the key driver of chassis supply models.*

1.3.4 Supply Chain Operation Preferences

The U.S. is largely unique from most other parts of the world with respect to at least two major supply chain processes.

First, due in large part to the ocean carrier chassis supply model and other terminal operating preferences, certain marine terminals and the vast majority of rail terminals store containers within the terminal on chassis ("wheeled" terminal). A "grounded" operation is the standard terminal operating model in the rest of the world, which does not require chassis to be stored on terminal for operating use (the implications of wheeled vs. grounded terminal operations for chassis supply are outlined in the following chapter).

A second factor differentiating the U.S. chassis structure from the rest of the world is the origin/destination logistics of loading/unloading the container. When a container is delivered to a shipper's facility for loading or unloading, it is common in the U.S. for the chassis to be unhooked from the tractor and left behind for loading/unloading. This is referred to as a "drop and hook" operation. The time that the container and chassis are left at the shipper's facility is contractually specified between the carrier and customer. Penalties for detaining a box at a customer facility are enforced after the maximum allowable "free days" have expired. Smaller shippers, some exporters, and several transload operations require the driver to stay with the container during the loading/unloading process. In most other parts of the world, the truck typically remains hooked to the chassis until the container is loaded/unloaded (referred to as "liveload/unload"). Although both types of operations are practiced in the U.S., the drop and hook operation is not common outside the U.S.

1.3.5 Governmental Regulation

The "roadability" rule was introduced in 2005 and became effective on June 17, 2009. This requires chassis equipment providers to operate a systematic chassis maintenance program, and requires users to inspect chassis and report certain defects to responsible parties. There are criminal and commercial penalties for non-compliance. The intended effect of this law, administered by the Federal Motor Carrier Safety Administration (FMCSA) (FMCSA is a branch of the Department of Transportation), is to increase the overall safety of the intermodal chassis fleet.

In most international jurisdictions, including Canada and Asia, there are no equivalent chassis-specific roadability laws. Instead, safety regulations generally apply to the truck as a unit (i.e., tractor and chassis or trailer).

The federal roadability law in the U.S. is perceived by some chassis equipment providers, including ocean carriers, as increasing the risk and liability of operating chassis and has been one reason that ocean carriers are seeking to exit the chassis business.

1.3.6 Terminal Labor

In the U.S., ocean container chassis domiciled at port facilities staffed by labor unions are governed by contract for union labor to inspect, maintain, and repair the units. Since approximately 75% of ocean container chassis are utilized at ports, the majority of U.S. chassis are inspected and maintained by terminal operators that contract labor through one of three unions: the

International Longshoremen's Association (ILA), the International Longshore and Warehouse Union (ILWU), and the International Association of Mechanics (IAM). Company signatories to the collective bargaining agreements include ocean carriers, marine terminals and maintenance companies. The union jurisdiction of maintenance and repair work has a long history going back decades, and their claim to continuing their responsibility for chassis maintenance and repair is one of the top issues for union management as they observe changes in chassis supply models.

Chassis leasing companies and motor carriers that own or operate chassis are not parties to the union–ocean carrier contracts. Motor carriers are not party to the master agreements and those that operate chassis are not subject to the same inspection and maintenance routine as signatory companies. The unions that have historically performed all chassis maintenance at marine terminals have concerns that as chassis provisioning transfers from ocean carriers (which require union labor for maintenance of chassis) to motor carriers (which do not), this could impact the quantity of union jobs. Therefore the unions are an interested and relevant stakeholder in the evolution of chassis models.

1.3.7 Liability Regimen

Due to high-profile truck road accidents in the past 15 years in the U.S., third-party liability coverage for chassis has become increasingly important for an equipment provider. For a motor carrier, minimum liability coverage of $750,000 is required by law[4], though the standard practice is to have $1 million. While there is no specific third-party liability coverage minimum required for ocean carriers, it has become customary to carry at least $20 million in liability insurance for chassis, with even higher amounts being carried by chassis pools, which also demand that maintenance and repair companies have sufficient liability insurance coverage.

With the evolution on the chassis model away from ocean carrier–controlled chassis in the U.S., the liability regime may be a factor to be considered by purchasers of intermodal transportation. Once the ocean carrier is no longer involved in the chassis operation, for example, other entities—such as motor carriers, terminal operators, and leasing companies—will be responsible for providing adequate liability insurance coverage.

In most other parts of the world, including Canada and Europe, liability insurance is a condition precedent to registering a truck for drayage purposes, although the coverage is not specific to the chassis. Minimum coverage requirements vary from region to region, but those in Europe, for example, are more or less on par with coverage requirements in the U.S. In many parts of Asia, it is common, but not required, for logistics and trucking companies to purchase third-party liability coverage. In many countries there is no minimum, but in China the typical insurance requirement is 1 million RMB (approximately $162,000).

In addition, ocean carriers often require minimum coverage as a condition of contract with motor carriers. In Canada, for example, shipping lines require proof of a minimum liability coverage ($1 million or more depending on the shipping line) before truckers are considered acceptable to haul their containers.

[4] For nonhazardous materials; liability for hazardous substances can range from $1 to $5 million (Title 49 CFR 487.9)

2 Chassis Supply Chain Operations

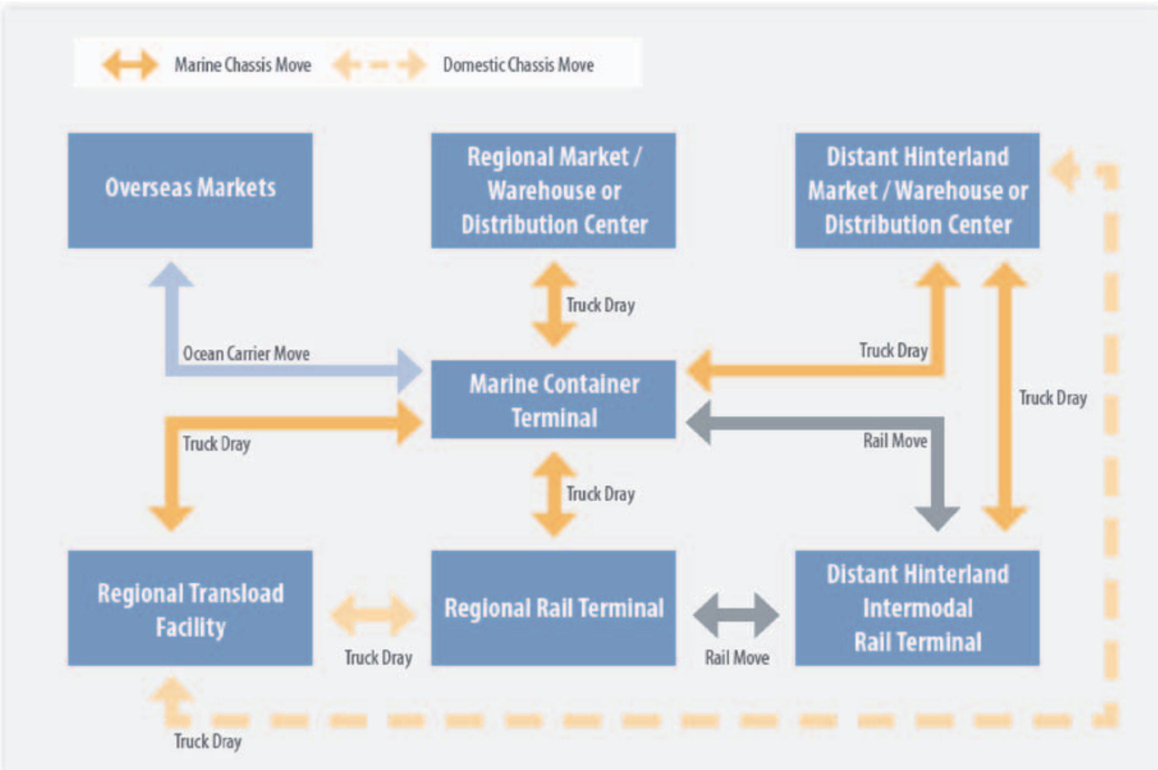
Key Messages

- **The terminal storage function can be "grounded," which requires stacking containers, or "wheeled" with containers stored on chassis.** Wheeled operations, more typical at inland rail terminals, usually transfer containers to draymen with one lift, but require a larger fleet of chassis, more land to store chassis, and containers on chassis.
- **Conventionally, ocean container chassis in the U.S. have been stored (parked, stacked, or racked) and managed within the terminal gate, which is unique to the U.S.** However, because of the need for additional acreage to increase container capacity, the storage of chassis at another location outside the terminal gate is a growing trend.

2.1 Role of Ocean Container Chassis in Freight Movement

Ocean container chassis serve critical functions in the movement and storage of full and empty ocean containers. With respect to the movement of containerized imports and exports, Figure 2-1 highlights the transportation moves in which the chassis is involved (orange arrows). A chassis is involved every time an ocean container moves by truck, irrespective of the type of move. Likewise, a domestic chassis is involved every time a 53' domestic container moves to and from a terminal (dotted orange arrows).

Figure 2-1. Use of Chassis in Import and Export of Containerized Freight



Source: CPCS.

In addition to the chassis' role in drayage operations, the chassis also provide a storage function, which is largely unique to U.S. supply chains. This takes place in the following two ways:

- **At a terminal site**: Storage of containers on chassis until ready for pickup (at a "wheeled" terminal, described in more detail in Section 2.2 below). Wheeled facilities are most typical of rail terminal operations.
- **At the shipper's facility**: Often containers and the chassis on which they rest are unhooked from the tractor and left at the shipper's facility for unloading and picked up later (drop and hook operation). In some instances, the container and chassis can be left at a shipper's facility for a prolonged period of time (free time), thereby representing additional storage space at that shipper's facility.

Chassis supply chain operations at terminals and BCO facilities and relevant distinctions are described in Sections 2.2 and 2.3, respectively.

2.2 Chassis Operations at Terminals

Conventionally, the ocean carrier chassis supply model required the pickup/drop off of a chassis or chassis container for every import container transported, in-gate inspections upon the motor carrier returning the chassis, and the storage, maintenance, and repair of chassis within the terminal gate. As with the evolution of chassis supply models, this is no longer always the case.

In terms of how the chassis interfaces with the terminal, there are primarily two key distinctions, as follows:

1. Whether chassis are part of the container staging and storage operation at the terminal (wheeled vs. grounded terminals).

2. Whether the driver arrives at the terminal with a chassis or must pick one up.

It is relevant to review the implications of these two key terminal model distinctions and others as they have important and varying implications for alternative chassis supply models.

2.2.1 Wheeled Versus Grounded Terminals

Intermodal terminals consist of three interactive operations: gate, transferring (ramp/berth), and storage.

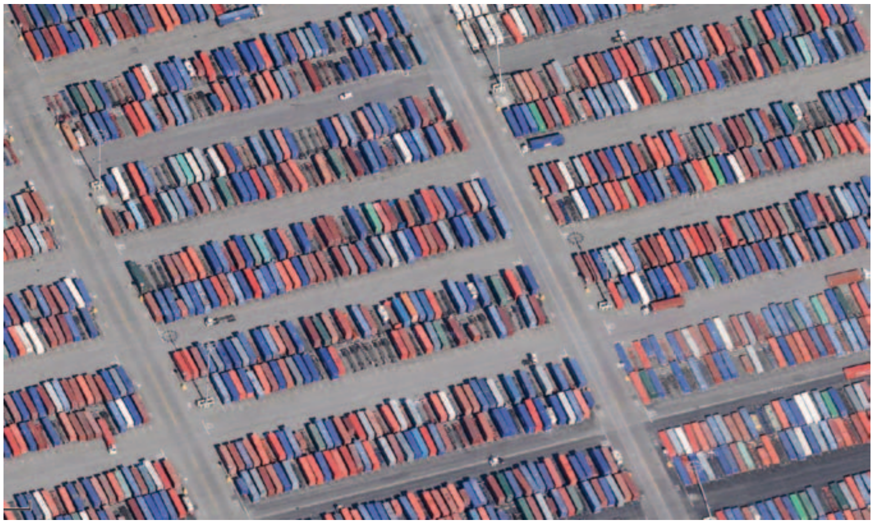
The storage function can be "grounded," in which case containers are stored in the container yard by stacking them upon one another, or "wheeled," with containers stored on chassis (Figure 2-2). In wheeled terminals, containers coming off a vessel or train are directly transferred to a chassis, and thus the chassis is an active element of terminal operations (Figure 2-3).

A grounded operation is the standard terminal operating model in the rest of the world, which does not require chassis to be stored on terminal for operating use. Due to operating preferences, U.S. rail and certain marine terminals maintain a portion of containers on chassis, which then does require chassis to be stored, and thus maintained, on terminal.

Figure 2-2. Grounded Operations at Hanjin Terminal, Port of Long Beach

Source: Port of Long Beach.

Figure 2-3. Wheeled Operations at APL Terminal, Port of Long Beach



Source: Google Maps.

Many terminals are neither all-wheeled, nor all-grounded (stacked) operations. A percentage of a grounded terminal's space is typically reserved for wheeled operation (e.g., high-priority, hazardous, or refrigerated cargo), and wheeled teminals switch to stacked operations when they run out of places to park chassis/containers, or when they run out of chassis.

Wheeled operations usually transfer containers with one lift, but require a significantly larger fleet of chassis, more land to store chassis, and containers on chassis. Usually there is also more yard tractor time and mileage driving to and from the storage area.

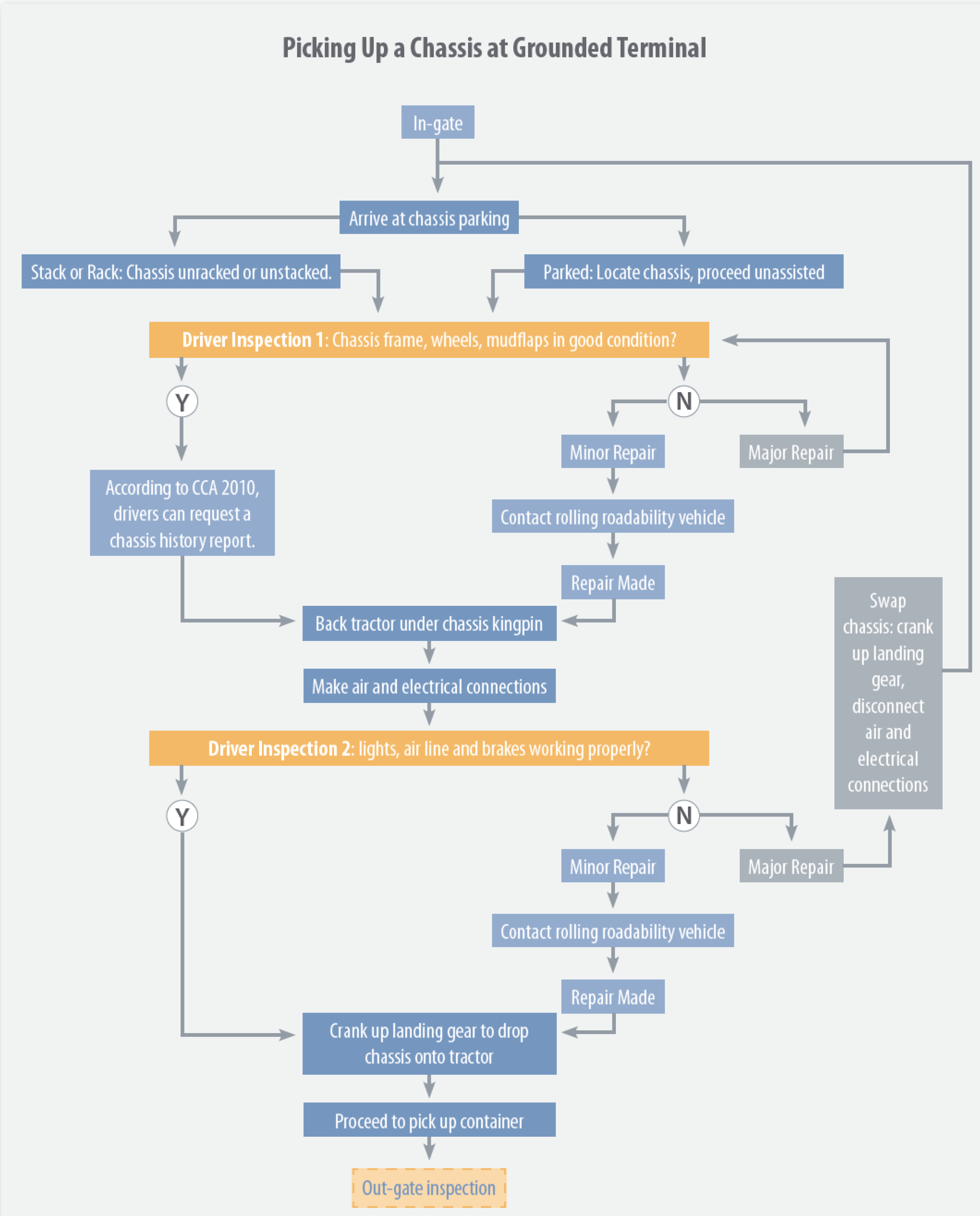
Chassis Flips

Chassis flips occur when there is a need to transfer a container from the chassis it is resting upon to another chassis. The incidence rate of chassis flips performed at marine and rail terminals varies but is generally on the order of about 5% of the total volume of intermodal transfers, based on terminals consulted (but could be more or less). Chassis flips nevertheless can create significant delays. There are five reasons for a chassis flip, ranked below by prevalence:

1. Bad order chassis (defective chassis),
2. Mismatched (wrong pool) container and chassis,
3. Driver brings his own chassis at a wheeled terminal,
4. The chassis cannot leave the terminal (rail), and
5. Container is stored on a chassis not suitable for the container weight.

The following figures provide an overview of the process for picking up and dropping off a container at a grounded terminal (Figure 2-4), a wheeled terminal (Figure 2-5), and returning a chassis or wheeled container (Figure 2-6). Where steps do not happen in all instances, their boxes have dashed-line borders. These processes are generic and may not exactly match all chassis operations nationally.

Figure 2-4. Chassis Operations at a Grounded Terminal



Source: Adapted from *NCFRP Report 11: Truck Drayage Productivity Guide*, The Tioga Group et al., Transportation Research Board of the National Academies, Washington, D.C., 2011.

Figure 2-5. Chassis Operations at a Wheeled Terminal

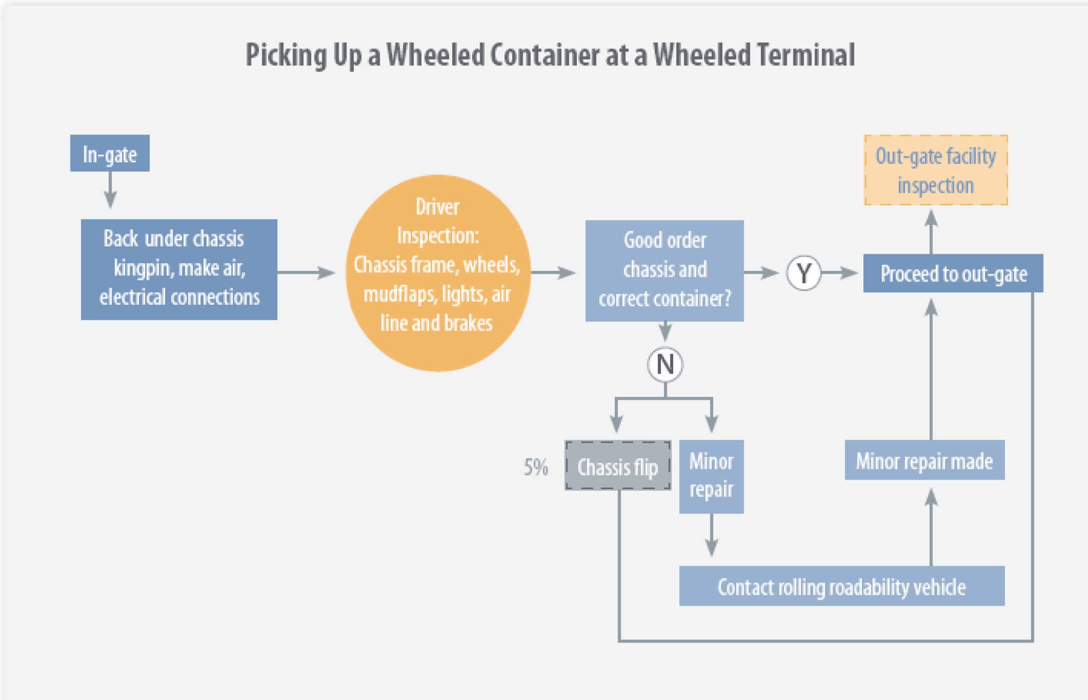
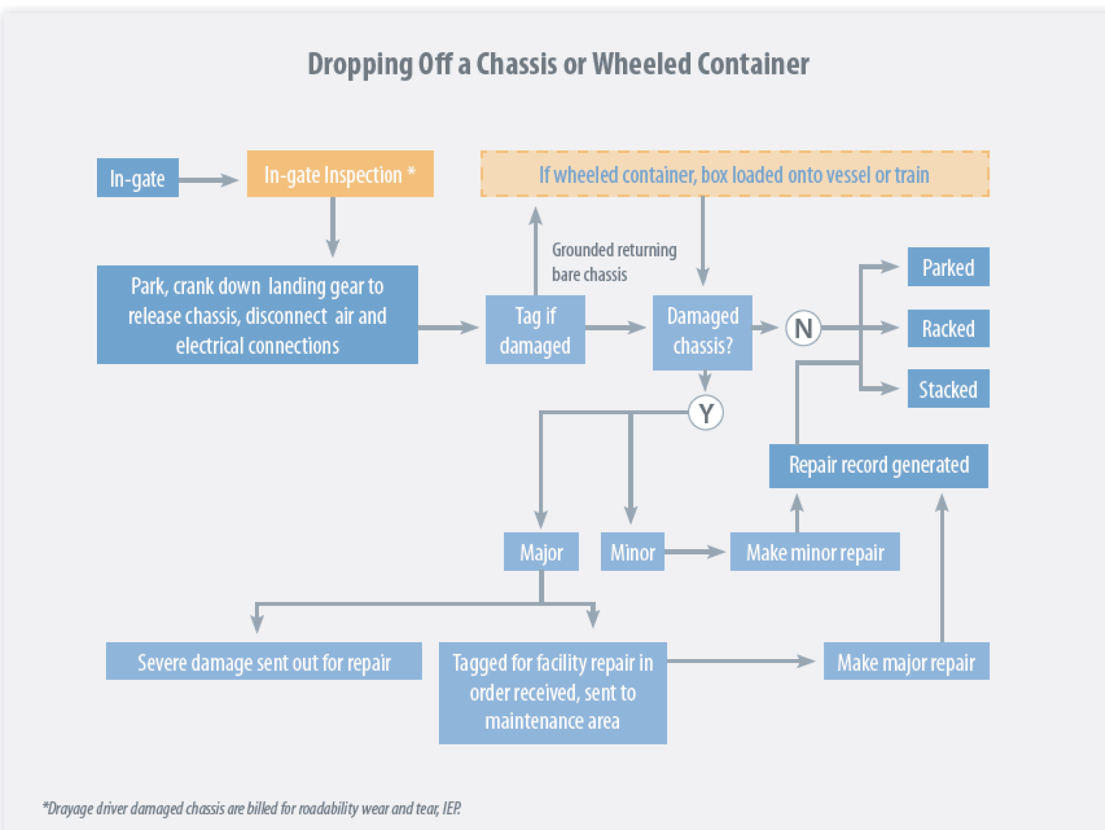


Figure 2-6. Returning a Chassis to the Terminal



2.2.2 On-terminal Versus Off-terminal Chassis Storage

Conventionally, ocean container chassis in the U.S. have been stored within the terminal gate, but because of the need for additional acreage to increase container capacity, the storage of chassis at another location outside the terminal gate is an emerging practice, though not prevalent. Off-terminal chassis storage is not an option for wheeled terminals because chassis are required for operations – containers are directly loaded to a chassis for trucker pickup. A grounded terminal has the option of whether or not to domicile chassis. A greater share of motor carriers arriving at the terminal with their own chassis not only eliminates the need to supply a chassis at the terminal, but also increases throughput: every acre not needed for chassis storage is an additional acre available for container storage.

Chassis Storage

When chassis need to be stored more efficiently than simply being parked, they are either stacked or racked (Figure 2-7).

Figure 2-7. Examples of Chassis Storage: (a) Stack and (b) Rack

(a) Chassis Stack **(b) Chassis Rack**

Source: Prime Focus LLC.

The number and nature of truck moves differ depending on whether the chassis is domiciled within or outside the terminal gate. A number of permutations are possible, depending on whether the terminal operation is grounded or wheeled (note: there is no off-terminal chassis storage/pickup in wheeled operations), and whether the loading/unloading operation at the BCO's facility is a drop and hook vs. a live-load/unload operation. For illustrative purposes, the following simplified Table 2-1 compares the number and nature of truck moves for an ocean container import move under three chassis storage scenarios: on terminal, off terminal, and at the motor carrier's facility. This illustrative example is for a grounded terminal operation and live-unload scenario, and assumes a same-day process.

Table 2-1. Truck Move Sequence for Delivering an Import Container from a Grounded Terminal to a Customer Facility (Live-Unload)

On-Terminal Chassis Storage	Off-Terminal Chassis Storage	Motor Carrier Storage (at Motor Carrier's Facility)
Leave motor carrier yard bobtail, move to terminal	Leave motor carrier yard bobtail, move to chassis yard	Leave motor carrier yard bare chassis, move to terminal
Terminal in-gate: truck arrives bobtail	Chassis yard in-gate: bobtail in, pickup chassis	Terminal in-gate: truck arrives bare chassis
Pick up chassis	Chassis yard out-gate: bare chassis	Terminal out-gate: chassis and full container
Proceed to pick up a container	Truck move to terminal	Truck move to customer for live-unload
Terminal out-gate: chassis and full container	Terminal in-gate: bare chassis in, pick up container	Truck move from customer to terminal
Truck move to customer for live-unload	Terminal out-gate: with chassis and full container	Terminal in-gate: chassis and empty container, drop off empty
Truck move from customer to terminal with empty container	Truck move to customer for live-unload	Terminal out-gate: bare chassis
Terminal in-gate: chassis and empty container, drop off empty	Truck move from customer to terminal with empty container	
Terminal out-gate: bobtail	Terminal in-gate: chassis and empty container, drop off empty	
	Terminal out-gate: leave with bare chassis	
	Truck move terminal to chassis yard	
	Chassis yard in-gate: drop off bare chassis	
	Chassis yard out-gate: bobtail	

Using this illustrative example, on any single move, the off-terminal chassis storage construct increases the number of truck moves and number of gate transactions compared to on-site chassis storage.

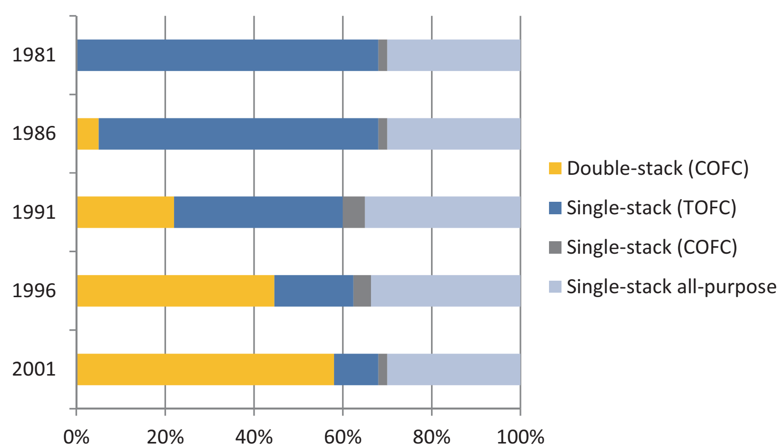
2.2.3 Difference Between Marine Terminal and Rail Terminal Operations with Respect to Chassis

There are a few important distinctions between rail and marine operations.

One salient factor is the greater prevalence of wheeled operations at rail terminals than at marine terminals. On the whole, rail terminals make up the majority of wheeled operations, with marine terminals increasingly grounded partially, if not totally, making grounded the more predominant model on the whole. Most rail terminals have to handle both TOFC (trailer on flat car) and COFC (container on flat car) services. Wheeled terminals are a legacy of handling trailers, which accounted for over 70% of the market as recently as the early 1980s (see Figure 2-8).

An important shift in the composition of the North American intermodal rail fleet took place in the late 1980s and early 1990s. The development of long distance corridors linking major port gateways such as Los Angeles/Long Beach to inland destinations incited the setting of double-stacked unit train services and a shift toward double-stacked COFC. The TOFC services that used to dominate became marginal. The main reason relates to a more efficient usage of rail assets permitted by double-stacked services as well as the commitment of trucking companies to integrate their drayage services with long distance intermodal rail services. What used to be carried as TOFC (without the use of a container chassis) is now carried as COFC (with a drayage segment) for the first/last mile, using a chassis.

Figure 2-8. Composition of the North American Intermodal Rail Fleet (%)



Source: adapted from T. Prince "Towards an international intermodal network," *American Shipper*, November, 2001.

The transition away from TOFC rail fleet is opening additional opportunities for rail terminals to shift away from wheeled operations to higher density grounded (stacked) operations. This has important operating implications for chassis, particularly at wheeled terminals, where chassis are used as part of the storage function. Yet, wheeled operations are more difficult to convert to grounded operations at existing rail terminals as most rail terminals must handle both containers and trailers (lift equipment must service both).

For rail operations, there is a higher likelihood of mismatched containers and chassis because the railroads handle equipment from many different ocean carriers, which often belong to different chassis pools. There may be enough chassis in the terminal, but there might not be enough chassis from a particular ocean carrier or pool. As a result, the railroads have to store more different types of chassis, including domestic chassis as well as multiple sizes of marine chassis.

Chassis needs planning can be very different between port and rail operations. In terms of container pickup, the railroads generally have shorter free time allowances (24 to 48 hours versus 4 to 5 days), which results in shorter chassis dwell times. The volume and nature of container flow (the peaks and troughs of chassis demand) also differ at wheeled marine and rail terminals. For example, a large marine terminal may unload 3,000 containers onto chassis from each of the three vessels calling in a week, while a large rail terminal unloads 240 containers to chassis for each of the ten inbound trains a day.

2.3 Chassis Operations at BCO Facilities

There are two basic chassis operations with respect to the loading/unloading of ocean containers at the BCO's facility (Figure 2-9):

Drop and Hook:

The container and chassis is disconnected from the tractor and left behind at the BCO's facility for loading/unloading. The period of time that the chassis is left at the BCO's facility is referred to as "free time" and is defined in the service terms of a private contract.

In a drop and hook operation, the motor carrier could leave the BCO's facility without a chassis (bobtail), or with another chassis and container (full or empty). Drop and hook operations are often used by large BCO's who are trying to optimize warehouse labor and stage loads for product flow reasons within the warehouse operations.

In the U.S., where chassis have conventionally been provided by ocean carriers as part of their service, shippers have often negotiated to hold on to the container and chassis with corresponding "free time" as part of the delivery service (this is a contractual term of service). In most jurisdictions abroad, where the chassis is supplied by the motor carrier or a logistics company, the tractor typically remains hooked to the chassis and is redeployed quickly for other drayage operations.

Live-Load/Unload:

The container and chassis remains hooked to the tractor and is loaded/unloaded in real time at the BCO's facility, while the driver stays with the equipment.

In the case of a live-unload operation, the truck operator waits with the chassis at the importer's facility until the container unloading operation is complete, after which the truck and chassis go to the terminal with an empty container, or onward to another facility for the container to be reloaded. Conversely, in the case of a live-load operation, the container on chassis will arrive at the BCO's facility empty and be loaded before returning to the terminal for onward carriage.

Live loads and unloads are typically used by BCOs with very limited parking space at their facility and are typical for high value loads and/or low volume shippers/receivers.

Figure 2-9. Chassis Operations at the BCO's Facility

3 Chassis Supply Models

Key Messages

- **(Conventional) Ocean Carrier Chassis Supply Model:** Chassis are owned (or leased) and operated individually by ocean carriers. Chassis are managed and maintained by the related ocean carriers.
- **Regional Cooperative (Co-op) and Alliance Co-op Chassis Pools Supply Model:** Chassis fleets are shared between member contributors, who have the responsibility to manage or delegate the management of the operation [e.g., Consolidated Chassis Management (CCM)].
- **Neutral Chassis Pools Supply Model:** Chassis are provided and operated by a third party, and users are charged a per-diem rental rate, which includes related costs, but not repositioning.
- **Terminal Chassis Pools Supply Model**: Several marine terminals either require or offer their own chassis pools to better control the chassis operation as part of the entire terminal process. The terminal may provide the chassis (like a neutral pool) or simply manage them (like a co-op pool). The terminal is responsible for management, maintenance, and storage.
- **Motor Carrier or Logistics Company–Owned (or Leased) and Operated Chassis Supply Model:** The motor carrier or logistics company operates its own chassis and assumes all related costs and responsibilities. This model is the international standard.
- **There is a growing trend for ocean carriers working with third parties to invoice motor carriers** for chassis usage charges in any of the above models (except for motor carrier chassis supply model).

3.1 A Brief History of the Evolution of Chassis Supply in the U.S.

The original intention of maritime container shipping, founded by Malcolm McLean in 1957, was to avoid the transfer of cargo between modes and essentially ship the truck box as a unit, reducing wait time at the port and labor cost. Thus, McLean's shipping operation had to own and operate chassis to complete the movement of containers to the customer's door in order to compete with the truck service he was attempting to replicate. As shipping international freight in containers grew in popularity in the 1960s, ocean carriers considered their chassis assets as service differentiators, and marketed them as such.

(Conventional) Ocean Carrier Chassis Supply Model

As a result of the ocean carriers' investment in chassis assets, and as these assets frequently were disconnected from the tractor (as marine and rail terminal operating practices required the use of the chassis as an operating asset), the U.S. intermodal motor carrier model adapted accordingly. Drayage companies and "owner-operator" drayage service providers did not need to invest in chassis, as they were provided by the ocean carriers. Further, the ocean carrier provided ample "free time" at the customers' facilities, whereby containers on chassis were unhooked from the tractor and left behind for unloading.

> In this owner-operator drayage model, the drayage company, which may or may not actually own any trucks, dispatches, manages, and administers truck drayage activities to and from terminals, but does this primarily by sub-contracting the drayage work to individual truck owner-operators.

Cooperative (Co-op) and Alliance Co-op Chassis Pool Supply Model

Though ocean carrier "co-op chassis pools" existed by the start of the new millennium, they were mostly informal ventures created through the vessel-sharing agreements (VSAs) of the ocean carriers that formed in the mid-1990s with the mega-alliances. These ocean carrier co-op chassis pools were largely established to minimize chassis mismatches and balance requirements, to improve chassis utilization, and reduce terminal storage space requirements. The co-op approach also reduced chassis requirements in the order of 20%[5] as a result of these operating improvements.

As an accommodation to quickly developing ocean carrier chassis pools, CCM was born as a wholly owned subsidiary of the ocean carrier discussion group, Ocean Carrier Equipment Management Association (OCEMA), the U.S.-based industry association of 20 major ocean common carriers. Today CCM is the largest chassis pool operator in the U.S., controlling approximately 125,000 chassis in cooperative chassis pools across the country.

Recent Developments with Respect to Co-op Chassis Pools

Once a majority of the ocean container chassis were consolidated into ocean carrier chassis pools, eliminating chassis as a service differentiator, the ocean carriers, under the anti-trust protection of the OCEMA discussion group, started to plan how to discontinue ocean carrier chassis supply as a means to reduce the cost and complexity of U.S. container shipping operations. However, in August 2009, Maersk Line, which did not participate in CCM pools, was the first to take on an independent initiative and implement a model whose goal is to end the practice of providing chassis (Maersk has since sold it chassis leasing business—Direct ChassisLink Inc. (DCLI) to a private investor). Other ocean carriers have since followed with similar, albeit different approaches.

[5] Per input of ocean carriers consulted.

Neutral Chassis Pool Supply Model

Third-party chassis leasing companies and "neutral chassis pools," independent of ocean carriers and motor carriers, found niche business opportunities in supplying to new carrier entrants, acting as short-term "supply buffers" for existing lines that preferred leasing to purchasing assets, or by establishing their own chassis pools at some facilities.

Terminal Chassis Pool Supply Model

Terminal chassis pools are a minor factor in the overall ocean carrier chassis supply, as terminals generally have enough ocean carrier-supplied chassis to operate unique fleets on site for each customer. Nevertheless, the introduction of marine terminal–controlled chassis pools was largely the result of marine terminal land capacity constraints that started to be felt in the early 2000s with the fast growth of global trade and container volumes. Marine terminal chassis pools helped reduce the chassis storage footprint at these terminals, thereby easing capacity issues, and provided a more controlled chassis environment to maximize terminal efficiency. This terminal pool type is usually derived from a commercial decision by the terminal operating company to implement out of operational necessity. There are no railroad-controlled terminal chassis pools with respect to ocean container chassis. Instead, the railroads have opted to utilize co-op and neutral chassis pools.

Motor Carrier Chassis Supply Model

As will be discussed further in this Guidebook, motor carriers own and control a very small percentage of ocean container chassis because historically in the U.S. these chassis have been provided predominantly by ocean carriers. Those chassis owned by motor carriers are predominantly specialized (e.g., tri-axle) chassis used for the carriage of heavy cargo.

Evolution of Container Chassis Supply outside the U.S.

When containerization arrived in Europe in the 1960s, the limited available space at marine terminals and higher container-land density led to a model in which chassis were not stored at the terminal, but rather provided by motor carriers. By the time European ports developed new intermodal facilities at peripheral locations, the chassis management model was already well established. A similar evolution occurred in Asia and other major markets globally.

3.2 (Conventional) Ocean Carrier Chassis Model

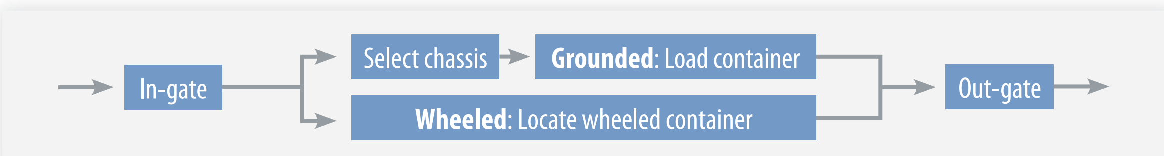
In this conventional U.S. model, chassis are owned (or leased) and operated by ocean carriers. They are also managed and maintained individually by the respective ocean carriers. For reasons described earlier, this chassis supply model is waning as ocean carriers seek to exit the chassis supply business, and now roughly only a third of marine chassis in the U.S. are operated directly by ocean carriers. To underscore this point, none of the ocean carriers consulted for this study had purchased chassis in recent years. But, as indicated by one ocean carrier, the exit from the chassis supply business has not been easy, noting that "once you start giving something away for free, or use it as a means of a competitive advantage, it is hard to extricate yourself."

The following summarizes the key characteristics of the ocean carrier chassis supply model.

Asset Ownership	Owned or leased by ocean carriers.
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by ocean carrier.
Facilities Agreement	Storage, inspection, and maintenance and repair usually contained within rail or marine terminal master transportation agreement.
Typical Metrics Used by Chassis Operators	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Asset utilization. • Street turn-time. • Out of service percentage.

From an operational standpoint, the general process for picking up a chassis and container for this chassis supply model is outlined in the Figure 3-1 below.

Figure 3-1. Process for Chassis and Container Pickup in Ocean Carrier Chassis Supply Model



3.3 Regional Cooperative (Co-op) and Alliance Co-op Chassis Pools Supply Model

In cooperative chassis pools, chassis fleets are shared between member contributors, who have the responsibility to manage or delegate the management of the operation. They were born out of two factors: the development of the carrier mega-alliances in the 1990s and the terminal capacity challenges in the 2000s.

There is no general physical operating difference between a regional co-op pool and an alliance co-op. A co-op's chassis are typically located within the terminal, although not necessarily.

> The co-op pool requires joint decision making by contributors. This is an important distinction because one of the principal challenges co-ops face is speed to action, as co-ops act on consensus and therefore need time for the democratic process.

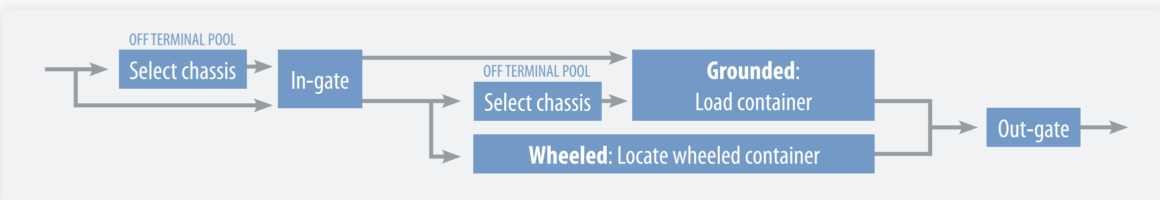
The CCM co-op pools allow for non-ocean carrier contributors to the pool; this arrangement is called a "Unitary Pool Concept" (UPC). Leasing companies and other companies owning chassis may act as a UPC, whereby they contribute their own chassis into the co-op and represent ocean carriers.

The following summarizes the key characteristics of the co-op chassis model.

Asset Ownership	Owned or triple-net leased by ocean carriers. Other entities (e.g., leasing companies) that own chassis may contribute to the pool.
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by professional management company, with contributing ocean carrier board oversight (e.g., CCM).
Facilities Agreement	Separate agreement necessary for storage, inspection, and maintenance and repair rules.
Typical Metrics Used by Chassis Operators	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Utilization: total pool, contributor, user, street turn-time, terminal dwell (dwell same as neutral pool).

From an operational standpoint, the general process for picking up a chassis and container for this chassis supply model is outlined in the Figure 3-2 below.

Figure 3-2. Process for Chassis and Container Pickup in Co-op Chassis Supply Model



The chief example of the co-op chassis supply models is CCM, which was started in 2005 to be the chassis pool operating company of the ocean carrier discussion group OCEMA. Additional information on the structure of CCM and a case study on CCM are provided in Appendix A, Section A.1.

3.4 Neutral Chassis Pools Supply Model

In this arrangement, chassis are provided/owned and operated by a third party, which is responsible for assets, demand/supply balance, repositioning, maintenance and repair, and insurance. Users (ocean carriers and motor carriers) are charged a per diem rental rate that includes a single daily rate for all the preceding, except repositioning.

Neutral pools, like all other pools, are known as "gray fleet" chassis and are usually domiciled at or very near terminals. Motor carriers who use neutral pool chassis may also use the equipment to move any carrier's containers, which can lead to enhanced labor and equipment productivity due to time savings from the interchange process.

Neutral pools were established by chassis leasing companies as a turnkey product for ocean carriers akin to the rental car business model. Neutral pools enable fast access to chassis to handle demand surges, and allow for quick off-hire when

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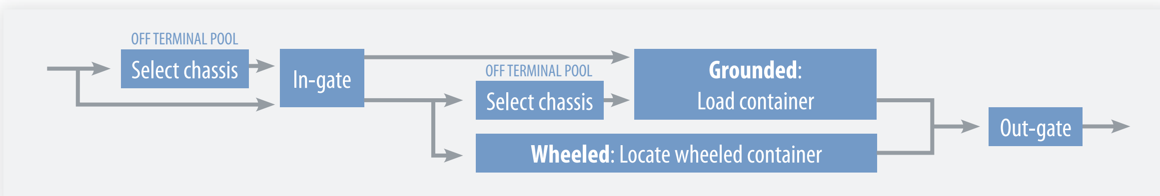
demand falls. Similar to co-op pools, they also usually offer multiple on-hire and drop-off points to allow for commercial flexibility of freight flows without having to physically reposition the chassis, though on a more limited basis.

The following summarizes the key characteristics of the neutral chassis pool model.

Asset Ownership	Owned by third party (typically a chassis leasing company).
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by neutral chassis pool operator, typically leasing company.
Facilities Agreement	Stand-alone agreement for storage, inspection, and maintenance and repair rules between pool operator and terminal, also known as a "hosting contract."
Typical Metrics Used by Chassis Operators	• Revenue rate per day. • Utilization: total pool, individual user. • Maintenance and repair cost per day. • Street turn-time. • Terminal dwell. • Out of service percentage.

From an operational standpoint, the general process for picking up a chassis and container for this chassis supply model is outlined in Figure 3-3 below.

Figure 3-3. Process for Chassis and Container Pickup in Nuetral Chassis Pool Supply Model



An example of this chassis supply model is the recently established Bay Area Chassis Pool (BACP), which is open to ocean carriers and motor carriers. The pool covers three marine terminals (Total Terminal Inc., the Oakland International Container Terminal, and Ports America Outer Harbor), the Union Pacific railroad, and two off-terminal container yards. A case study of this chassis supply model is provided in Appendix A, Section A.2.

3.5 Terminal Chassis Pools Supply Model

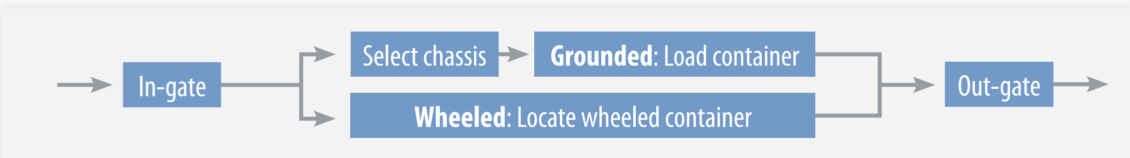
Several marine terminals either require or offer their own chassis pools to better control the chassis operation as part of the entire terminal process, or as a commercial convenience for their customers. These terminal-operated pools may be either neutral (the terminal owns/operates) or co-op (the terminal manages on behalf of the lines). The key differentiating factor is that the terminal operates, manages, and is the intermodal equipment provider (IEP) designation for U.S. Department of Transportation roadability regulation purposes.

The following summarizes the key characteristics of the terminal chassis supply model.

Asset Ownership	Ocean carrier, terminal, or leasing company may contribute.
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by terminal operator.
Facilities Agreement	None, since terminal operator controls both terminal and pool.
Typical Metrics Used by Chassis Operators	• Variable operating expense per day. • Loaded lifts/chassis. • Repositioning cost. • Utilization: total pool, contributor, user, street turn-time, terminal dwell (dwell same as neutral pool).

From an operational standpoint, the general process for picking up a chassis and container for this chassis supply model is outlined in Figure 3-4 below.

Figure 3-4. Process for Chassis and Container Pickup in Terminal Chassis Supply Model



SSA, one of the largest U.S. marine terminal companies, operates a terminal-controlled chassis pool at its two Seattle marine terminals (known as T-18 and T-30). SSA provides the assets, manages the chassis, and performs the maintenance. Ocean carriers have the opportunity to contribute their assets to the SSA pool. SSA also provides billing services for ocean carriers that are sub-leasing chassis to motor carriers through the SSA pool. A case study on SSA Pacific Northwest Pool is provided in Appendix A, Section A.3.

Another example of a co-op–based terminal model is the Hampton Roads Chassis Pool (HRCP) II, established in 2003 as the nation's first port-wide cooperative chassis pool, connecting all the marine terminals and rail facilities in the Norfolk, VA, area. Under this cooperative arrangement, the ocean carriers contribute chassis to support their cargo requirements, and a pool management company that is owned by the terminal operator manages the macro supply and maintenance. A case study on HRCP II is provided in Appendix A, Section A.4.

3.6 Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Supply Model

Chassis are owned (or leased) and operated by motor carriers or logistics companies. When picking up a container at a terminal, the motor carrier or logistics company will arrive at the terminal gate with its own chassis. Once the container is loaded onto the chassis at the terminal site, the motor carrier will deliver the container and chassis to the receiver's facility.

The general operational characteristics of this model are as follows: a) grounded/live-lift terminal operation, b) chassis normally stays hooked to the truck at all times during its operation, c) trucker stays with the container while it is loaded/unloaded at the cargo interest, d) off-terminal parking of chassis, and e) maintenance is performed by the owner.[6]

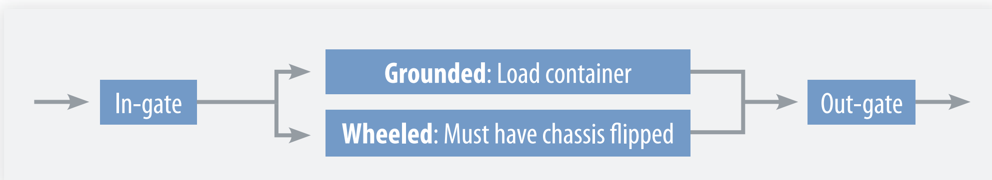
[6] Where a motor carrier provides exclusive haulage services in a trade lane, a "drop and hook" operation may exist.

The following summarizes the key characteristics of the motor carrier or logistics company chassis supply model.

Asset Ownership	Owned or triple-net term leased by motor carrier.
Management/ Operation	Chassis procurement, demand/supply, maintenance, logistics, administration, insurance activities performed by motor carrier.
Facilities Agreement	N/A - Motor carrier chassis stored off terminal.
Typical Metrics Used by Chassis Operators	• Operating cost per day. • Capital cost per day.

From an operational standpoint, the general process for picking up a chassis and container for this chassis supply model is outlined in the Figure 3-5 below.

Figure 3-5. Process for Chassis and Container Pickup in Motor Carrier or Logistics Company Chassis Supply Model



The South Florida region composed of the Port of Miami, Port Everglades, and the FEC Rail terminals is the largest concentration of motor carrier–operated chassis in the U.S. A case study of the motor carrier chassis model's prevalence in South Florida is provided in Appendix A, Section A.5.

3.7 Chassis Billing Models

Although some motor carriers have been accustomed to leasing neutral chassis pools for years (for specific commercial needs), motor carriers have never had a commercial relationship with ocean carriers exclusive to chassis. This situation changed in August 2009 when DCLI began operating chassis on behalf of Maersk, and commenced the practice of charging motor carriers a daily fee for the use of its chassis. This initiative was well-publicized in the trade press, garnered widespread attention from all intermodal stakeholders, and jump-started the larger industry effort to transition ocean carriers away from providing chassis for "free."

In short, DCLI became a chassis leasing company, though not in the traditional long-term operating lease sense of its competitors,[7] wholly owned by Maersk at the onset of this study. As of this writing, Maersk has announced and subsequently completed the sale of DCLI to the private investment firm, Littlejohn & Co., LLC, completing Maersk's divestment of chassis.

Other chassis leasing products are provided by leasing companies Flexi-Van and TRAC Intermodal. The three major "by the day" chassis lease products are summarized in Table 3-1 below.

[7] Within this study DCLI has been characterized as a leasing company though their operational model differs slightly from TRAC and Flexi-Van and their neutral pools may better be characterized as rental fleets.

Table 3-1. Evolving Chassis Billing Models: Entities Leasing Chassis to Motor Carriers "By the Day"

Brand Name	Program Description	Locations	Daily Rate	Billing Mechanics
Direct ChassisLink	• Formerly owned by Maersk Line (now Littlejohn & Co., LLC, per recent transaction). • Rents chassis directly to motor carriers for a fee, including maintenance.	• Nationwide. • Operates out of former Maersk-contracted facilities, including APMT, BNSF, CSX, and off-terminal depots.	$13-$15	100% moves invoiced to motor carrier.
TRAC Connect	• Owned by TRAC Intermodal. • Chassis leased directly to motor carriers for a fee, including maintenance and insurance. • TRAC also provides longer-term "triple-net leases" to the motor carrier, which is responsible for maintenance, insurance, and taxes.	• Operates on terminals where TRAC has established neutral pools, or on terminals within co-op pools. • TRAC Metropool in NY, NJ, Philadelphia, Baltimore. • TRAC Railpool on CSX locations. • TRAC's Gulf Regional Pool in Houston, New Orleans, Tampa, Mobile, and Dallas. • Within CCM pools in South Atlantic, Memphis, Kansas City, St. Louis, Denver, and Salt Lake and within SSA pools at Con Global locations in California.	$12-$15	Ocean carrier has flexibility to direct invoices based on Merchant/Carrier Haulage and "customer exception."
FlexiDay	• Owned by Flexi-Van. • Chassis leased directly to motor carriers for a fee, including maintenance and insurance. • Flexi-Van also provides longer-term "triple-net leases" to the motor carrier, which is responsible for maintenance, insurance, and taxes.	Operates from Flexi-Van depots in NY/NJ, South Atlantic, Midwest, BACP, and within CCM Pools in South Atlantic and Gulf.	$12-$15	In addition to the Flexi-Day Program, Flexi-Van direct invoices based on Merchant/Carrier Haulage and customer exception.

Source: Team research.

3.7.1 Competing Chassis Models Creating Confusion for Motor Carriers

As ocean carriers are individually developing their chassis exit strategy and implementing various motor carrier billing model solutions to progress their transition plans, the chassis landscape in some regions is evolving into an assortment of programs that is confusing motor carriers. The following box provides an example of the different models at play in one region.

Options in Oakland:

As an illustrative example, at the Port of Oakland, as of February 1, 2012, there are eight different chassis models that motor carriers must be cognizant of, and possibly participate in, to support their customer requirements:

In no particular order:

1. Ocean carrier provides for no charge (ocean carrier model)
2. Ocean carrier owns, motor carrier pays (CNS Equipment Inc./Hyundai)
3. Ocean carrier cooperative pool for no motor carrier charge [The New World Alliance (TNWA)]
4. BACP —ocean carrier pays (neutral pool)
5. BACP—motor carrier pays (neutral pool)
6. TRAC management of CMA within BACP—motor carrier pays
7. Direct ChassisLink – motor carrier pays (neutral pool)
8. BNSF/Flexi-Van rail pool—supplied by railroad

Of course, there is a ninth approach – the motor carrier can provide its own chassis.

As a motor carrier put it: "It's a headache to track. I feel like we've been guinea pigged, and the rates keep changing. You may get 5 days on the box and nothing on the chassis. We are an agent for the ocean carriers. We get charged, bill back the ocean carrier for the chassis. The leasing company wants to get paid right away and the ocean carrier doesn't pay quickly."

4 U.S. Chassis Supply: Regional Perspectives

Key Messages

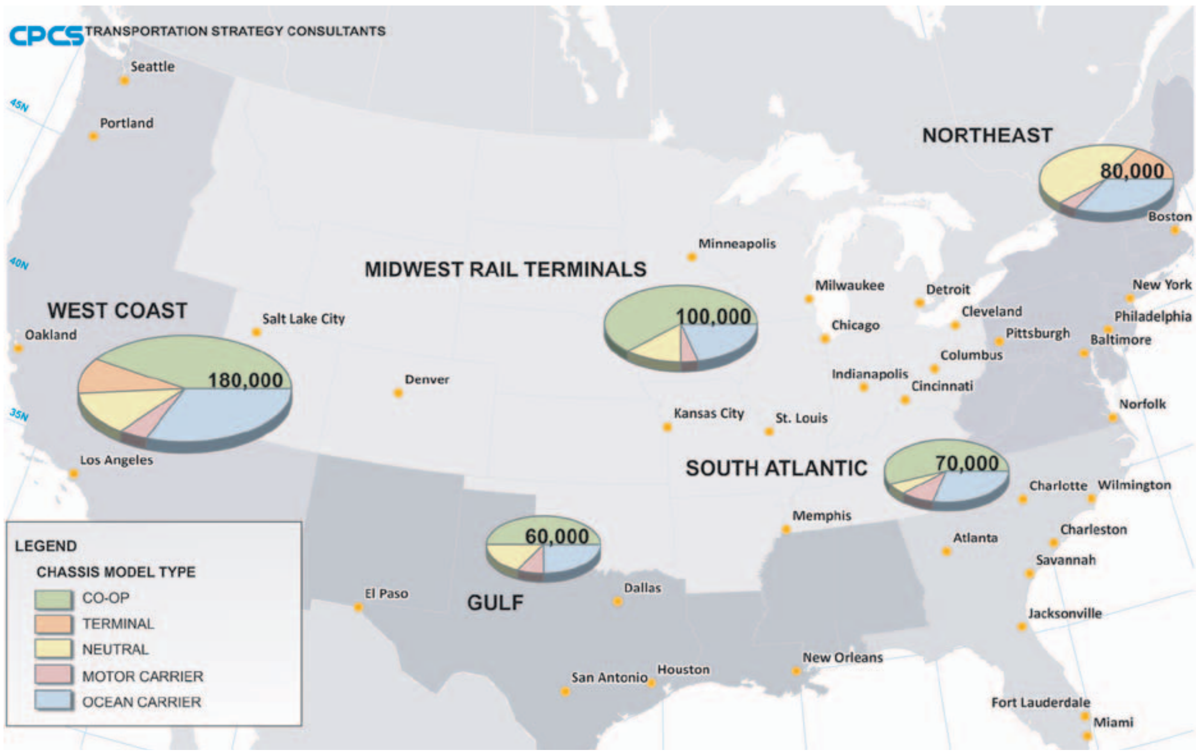
- **The prevalence of different chassis supply models, and the size of related chassis fleets, differs greatly by region.** But all chassis supply models are in play in each region.
- **Northeast**: Neutral pool model most prevalent (45%), followed by ocean carrier chassis supply model (35%).
- **In all other coastal regions (South Atlantic, Gulf, West Coast), the co-op pool predominates, followed by the ocean carrier model.**
- **Midwest (inland rail terminal)**: Co-op pool model most prevalent (60%), followed by ocean carrier chassis supply model (20%).
- **The motor carrier model is most significant in the South Atlantic and Gulf Regions,** but represents only 10% in both cases.
- **Marine and rail terminals exerted significant influence in the rise of chassis pools** over the past 10 years to alleviate terminal capacity constraints and improve operating conditions.

4.1 Regional Variations in the U.S. Supply Models

The prevalence of different chassis supply models and the size of related chassis fleets differs greatly by region; indeed, the U.S. chassis supply landscape is rather heterogeneous and has been evolving in response to different regional influences.

The following Figure 4-1 provides an overview of the regional distribution of active ocean container chassis in the U.S., by type of chassis supply model (excluded are chassis that are laid up or otherwise not currently in service). It should be recognized that this regional breakdown is an approximation and is continually evolving.

Figure 4-1. Approximate Active Chassis Supply Models by Region



Source: CPCS estimate and mapping of various data sources collected by the research team, including through consultations with industry stakeholders.

Tables 4-1 to 4-5 provide an overview of chassis supply models in each of these U.S. regions, including key players, major influencers, and their evolving context. Again, these figures represent active chassis and the discrepancy with the total population of 565,000 is accounted for by inactive and laid-up chassis.

Table 4-1. Northeast U.S. Chassis Supply Summary

Northeast	*Boston, NY/NJ, Philadelphia, Baltimore, Norfolk*	
	80,000 chassis (est.)	
Model	**Market Share**	**Description**
Ocean Carrier Owned and Operated	35%	On -terminal, controlled by ocean carriers.
Terminal Pool	15%	Hampton Roads (Norfolk) chassis pool.
Neutral Pool	45%	Includes TRAC Metro, Flexi-Van, Northeast Regional Pool (NERP) and DCLI.
Motor Carrier-Supplied	5%	Only includes motor carrier owned or long-term leased chassis where motor carrier is IEP.

In the Northeast, the neutral pool market share has increased by 15 percentage points in the last year as two co-op pools—Maher terminal (approximately 8,000) and NERP (approximately 4,000) have converted to neutral pools managed by TRAC Intermodal and Flexi-Van, respectively. The change to neutral pools was influenced by the ocean carrier's strategy to exit providing chassis. Since the conversion, several former co-op members have implemented or announced plans to eliminate providing chassis.

Table 4-2. South Atlantic U.S. Chassis Supply Summary

South Atlantic	*Wilmington, Charleston, Savannah, Jacksonville, Charlotte, Atlanta, Miami*	
	70,000 chassis (est.)	
Model	**Market Share**	**Description**
Ocean Carrier Owned and Operated	30%	On terminal, controlled by ocean carriers.
Co-op Pool	55%	On terminal, controlled by CCM operating company.
Neutral Pool	5%	TRAC Rail pool, Flexi pool (at rails) and DCLI.
Motor Carrier-Supplied	10%	Only includes motor carrier owned or long-term leased chassis where motor carrier is IEP.

In the South Atlantic, co-op pools predated the formation of CCM, which started its pool in 2007 by combining two multi-carrier co-op pools. The marine terminals in this region are operating terminals, two of which formed a discussion agreement to harmonize chassis operations because there is significant equipment flow between them. These operating terminals influenced the ocean carrier decision to support a single chassis pool (the CCM co-op).

Table 4-3. Midwestern U.S. Chassis Supply Summary

Midwest/Rail Only	*Chicago, Ohio Valley, Tennessee Valley, St. Louis, Kansas City, Denver/Salt Lake*	
	100,000 chassis (est.)	
Model	**Market Share**	**Description**
Ocean Carrier Owned and Operated	20%	On terminal, controlled by ocean carriers.
Co-op Pool	60%	Includes Chicago and Ohio Valley [Chicago Ohio Valley Consolidated Chassis Pool (COCP)], Mid-South (Memphis and Nashville), Midwest (St. Louis and Kansas City), and Denver Consolidated Chassis Pool (DCCP) (Denver and Salt Lake).
Neutral Pool	15%	TRAC Rail pool, Flexi pool (at rails) and DCLI.
Motor Carrier-Supplied	5%	Only includes motor carrier owned or long-term leased chassis where motor carrier is IEP.

The railroads partnered with their ocean carrier customers to develop co-op pools in this region as terminal capacity constraint occurred in the middle part of the past decade. Prior to this effort, most ocean carriers operated their own chassis fleet. Since chassis were predominantly stored on-terminal, reducing the number of units to likewise reduce chassis storage acreage was the main objective. Like the marine terminals in the South Atlantic, the railroads influenced the ocean carriers to support a single pool, which promoted the efficiency of the gray fleet concept.

Table 4-4. U.S. Gulf Region Chassis Supply Summary

Gulf Region	*Houston, New Orleans, Mobile, Dallas/Ft. Worth, San Antonio, El Paso*	
	60,000 chassis (est.)	
Model	**Market Share**	**Description**
Ocean Carrier Owned and Operated	25%	On terminal, controlled by ocean carriers.
Co-op Pool	50%	On terminal, controlled by CCM operating company.
Neutral Pool	15%	TRAC Gulf Regional pool, Flexi pool (at rails) and DCLI
Motor Carrier-Supplied	10%	Only includes motor carrier owned or long-term leased chassis where motor carrier is IEP

The Gulf region traditionally has had a fairly significant share of chassis pooled, and prior to CCM there were two large neutral pools, operated by TRAC and Flexi-Van. The ocean carriers decided in 2008 to expand the co-op efforts to the Gulf, and with the support of the railroads consolidated many of the ocean carriers that had participated in the neutral pool into the CCM product.

Table 4-5. West Coast U.S. Chassis Supply Summary

West Coast	*LA Basin, Oakland, Pacific Northwest (Portland, Tacoma, Seattle)*	
	180,000 chassis (est.)	
Model	**Market Share**	**Description**
Ocean Carrier Owned and Operated	33%	On terminal, controlled by ocean carriers.
Co-op Pool	43%	• Grand Alliance Co-op pool in Los Angeles Basin Pool (LABP) co-op pool of several ocean carriers, managed by Flexi-Van. • TNWA [APL, MOL, Hyundai Merchant Marine Co., Ltd. (HMM)] VSA co-op. • Marine terminals a mix of grounded and wheeled, while rails are wheeled.
Terminal Pool	8%	• SSA pools in Los Angeles, Oakland, and Pacific Northwest. • ITS in Long Beach.
Neutral Pool	11%	• BACP, owned and managed by Flexi-Van in Oakland. • DCLI.
Motor Carrier-Supplied	5%	Only includes motor carrier owned or long-term leased chassis where motor carrier is IEP.

Fourteen marine terminals operate in the LA-Long Beach port complex, many of them either wholly operated by ocean carriers or in a joint venture with marine terminal operating companies. The development of the mega-alliance movement in the mid-1990s gave rise to three major alliances—TNWA (APL, MOL, HMM), Grand Alliance (NYK, Hapag-Lloyd, OOCL), and CKYH (Cosco, "K" Line, Yang Ming, and Hanjin)—and container and chassis flow among and between marine and rail terminals dramatically increased. Each alliance created its own co-op chassis pool to dramatically reduce container/chassis mismatches for wheeled import cargo and to reduce chassis repositioning expenses.

5 Alternative Chassis Supply Models: Stakeholder Perspectives

Key Messages

- **Different supply chain stakeholders have different and, in many cases, divergent interests with respect to chassis supply.** Likewise, the perceived advantages and disadvantages of alternative chassis supply models also differ by stakeholder.
- **BCOs' interest in chassis goes no further than cost and service.** In the traditional approach the chassis was a hidden cost; BCOs expect no impact to chassis availability with the model transition, but prefer the status quo of ocean carriers as well known and understood.
- **From an ocean carrier perspective, chassis pools are an intermediate step** in the ultimate end game to transition chassis responsibility fully to the motor carrier. Ocean carriers have no plans to invest in new chassis.
- **Motor carrier interests are focused on productivity and maximizing turn times.** Pool models tend to respond well to these interests. Barriers to motor carrier chassis supply include need for storage, increased chassis-related capital and operator costs, and conflicts with wheeled terminal operations.
- **Terminal operators seek terminal productivity—currently on-terminal chassis occupy valuable terminal land.** Terminals prefer the motor carrier chassis supply model, which would move chassis off-site, but few believed a significant transition was realistic in the short term.

5.1 Different Stakeholders, Different Interests and Needs

Many stakeholders have an interest in ocean container chassis supply. These stakeholders include, but are not limited to the following:

- BCOs—importers and exporters;
- Ocean carriers;
- Motor carriers;
- Terminal operators (marine and inland); and
- Public agencies and planning organizations, including port authorities.

Each of these stakeholder groups has distinct interests vis-à-vis chassis supply. Likewise, each stakeholder group has different performance needs, expectations, and measures with respect to chassis supply and supply chain performance.

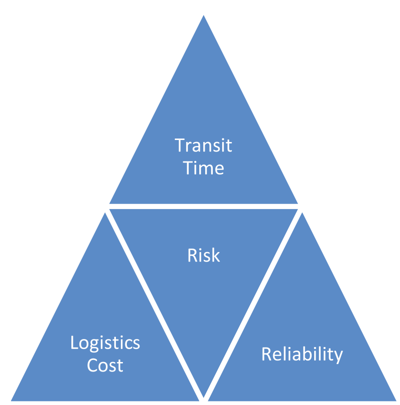
Often, these interests and performance needs are distinctly unaligned among various stakeholders. For instance, BCOs typically do not see chassis and containers as separate, but in any case tend to prefer a perennial supply of chassis to minimize any transit delay resulting from chassis-related service failures. This is also the case for most motor carriers that want to increase driver productivity, maximize driver turn times, and minimize delays in sourcing chassis. On the other hand, marine and rail terminal operators want to minimize the amount of chassis needed within the terminal to support container operations, as chassis tie up costly capital, and can be a poor use of scarce terminal capacity. For public agencies and planning organizations, land-use, congestion, and environmental implications, among others, are of particular interest (discussed in the following chapter), whereas chassis leasing companies tend to be focused on maximizing a return on their chassis assets, specifically.

As chassis supply models evolve in the U.S., these different interests can lead to tensions among competing stakeholders. These tensions will in turn influence the evolution of chassis supply in the U.S., although it is too early to determine just how and to what extent.

In an attempt to make sense of the implications of evolving chassis supply models for different stakeholder groups, the section below provides an overview of the interests and motivations of each key stakeholder group with respect to chassis supply, as well as the advantages and disadvantages of each alternative chassis supply model vis-à-vis these specific interests and motivations. This section is largely informed by the more than 80 stakeholder consultations undertaken as part of the research effort for this Guidebook.

5.2 Beneficial Cargo Owners

Broadly, BCOs, both importers and exporters, have three primary interests and performance needs with respect to the movement of goods within their supply chains: total logistics costs, transit time, and reliability. Supply chain decisions and operational considerations, including mode selection, frequency and distribution, and warehousing models are made on the basis of appropriate trade-offs among these performance drivers and related risks and are largely dependent on the nature of the goods being shipped and related supply chain performance parameters (time to market and inventory turn frequency, product cost, customer needs, etc.).



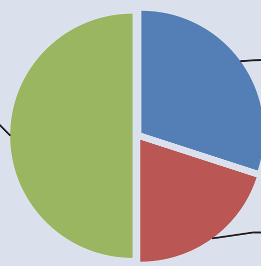
Source: CPCS.

Historically, chassis supply matters have only been visible and of concern to shippers when chassis shortages or service problems affected their supply chains. Nevertheless, the evolving chassis supply models are increasingly of concern to BCOs, which have questions about service levels, related risks and the extent to which chassis-related charges may get passed along to them.

Profile of BCOs Consulted

Ten BCOs were consulted in the development of this Guidebook, including importers and exporters and covering a range of containerized cargo including consumer packaged goods, manufactured and industrial products, chemical and agricultural commodities, among others.[8] These BCOs ranged in size—the smallest moved 100 twenty-foot equivalent unites (TEUs) per year, and the largest moved over 300,000 TEUs per year. From a geographic standpoint, the sample consulted collectively utilized all major container marine ports in the U.S. as well as all major inland rail terminals. Together the annual traffic generated by the BCOs consulted is in the order of 1 million TEUs and roughly 750,000 drayage moves. While this sample only represents a fraction of U.S. containerized imports, exports, and drayage moves, the researchers expect this group to be sufficiently representative of BCO perspectives with respect to ocean container chassis supply in the U.S. The Retail Industry Leader Association (RILA) was also consulted.

The majority of BCOs consulted reportedly had a very good understanding of chassis operations as they related to their own supply chains. The following provides a snapshot of the relative "Chassis IQ" of BCOs consulted, and is based on a survey question asking each to rate their level of understanding of chassis operations from "no understanding at all" (which no respondent selected), to "very familiar…."



5.2.1 Commercial Needs and Interests vis-à-vis Chassis Supply

BCOs purchase ocean transportation and select "port to port" terms (merchant haulage) or "port to door/door to port" terms (carrier haulage) from ocean carriers. These terms indicate which party is responsible for the "first mile/last mile" drayage to/from BCO facility to intermodal terminal. For port to port, the BCO is responsible to contract with motor carriers for drayage; for port to door/door to port, it is the ocean carrier. In either case, historically the ocean carrier has included the chassis in the contractual terms of carriage. From the BCO's standpoint, the evolving chassis supply landscape is particularly salient with respect to merchant haulage as this may require BCOs to arrange and pay for their own chassis, when they did not previously.

Although rarely a primary consideration for BCOs, commercial needs with respect to chassis supply vary depending on a number of factors, including approaches to managing warehousing and distribution facilities, the need for additional storage space, among others. These needs often extend beyond chassis to container supply and related terms.

The following factors with respect to chassis (and container) supply were identified by those BCOs consulted as being of particular importance to their operations and to the chassis supply model transition:

- **Service Risk**: BCOs care most about avoiding chassis-caused service failures, that is, a delay to the cargo transportation plan. This issue relates to having the right chassis at the right place at the right time.

[8] With the exception of Target Stores Inc., all BCOs consulted did so under condition of non-attribution.

- **Service Terms**: The terms of delivery and chassis supply operations at the BCO's facility, including live-unload versus drop and hook and "free time."
- **Cost*** (see box below): As applicable, this consists of costs associated with the chassis (and container) use, explicit or implicit, current or expected in the future, including penalties relating to exceeding free time allowances. It should be noted that at present, many BCOs are provided chassis in their bundled contracts with the ocean carriers and do not know what the direct chassis costs are as these are not invoiced separately.
- **Quality and Safety**: Partly a sub-set of service delivery, shippers are sensitive to delays caused by equipment operations failures and are also cognizant in varying degrees of the newly enacted federal laws on chassis roadability and other FMCSA regulations.
- **Liability**: BCOs are sensitive to liability implications associated with transitioning chassis supply responsibility away from the ocean carriers.

Service terms, including chassis free time allowance, are typically negotiated with the provider. The larger U.S. shippers occupy a strong position to negotiate preferred chassis supply terms and conditions with carriers, in large part on account of the revenue they provide to these carriers and the stability of this demand. Smaller BCOs have less market power in negotiating service terms, and may use split shipments managed by third-party logistics (3PL) providers or non-vessel operating common carriers (NVOCC), which in turn contract with carriers for chassis supply.

***Cost**

Separate chassis costs to the BCO are not driven by the different chassis supply models per se. BCOs could be liable for chassis charges under any chassis supply model.

There are different billing mechanisms for chassis use under each supply model, as referenced in Section 3.7. While there are exceptions, the general chassis billing models, from the BCO perspective, are as follows:

- **Carrier haulage:** BCO exempt from separate charge since ocean carrier supplies chassis as part of terms of transportation.
- **Merchant haulage:** Where a separate charge is applied, BCO pays for chassis through charges included in the motor carrier invoice.
- **Exception:** Large BCOs may be exempted from merchant haulage chassis charges per commercial considerations.

BCO Performance Metrics with Respect to Chassis Supply

BCOs are generally not concerned with the chassis specifically, but rather their containers since the BCO focus is the cargo they have paid for, particularly its inventory management. Typical metrics such as on-time performance, dwell time, detention charges, and equipment availability are monitored, but the chassis as an asset is not specifically monitored.

All but one BCO consulted indicated that they did not currently pay separate chassis supply charges. However, many suggested that the potential introduction of separate chassis charges may lead to different chassis management methods. For example, some manufacturers indicated that visibility of a chassis cost center might lead to changes in approaches to transportation purchasing and related chassis supply terms.

5.2.2 Advantages and Disadvantages of Alternative Chassis Supply Models for BCOs

From the perspective of BCOs, the advantages and disadvantages of alternative chassis supply models are presented Table 5-1 below, with a focus on the implications to their specific commercial interests, as outlined in Section 5.2.1 above.

Table 5-1. Advantages and Disadvantages of Alternative Chassis Supply Models from the Perspective of BCOs

Chassis Supply Model	Advantages	Disadvantages
Conventional(Ocean Carrier Chassis Model)	• **Service Risk and Terms:** No change to status quo. • **Quality and Safety:** Status quo. • **Liability:** Maintains status as "non-issue" for BCOs, as covered by ocean carriers.	• **Service Risk**: Greater risk of individual ocean-carrier caused service failure due to market chassis shortages relative to pool models.
Chassis Pools (Co-op Model, Neutral and Terminal-Controlled)	• **Service Risk and Terms:** Less service risk than ocean carrier and motor carrier models. • **Quality and Safety:** Pool models generally have a maintenance program. • **Liability:** Maintains status as "non-issue" for BCOs. Pools generally have better liability regimen than individual ocean carriers and motor carriers.	
Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Model	• **Quality and Safety:** Potential for increased qualify/safety of chassis if maintenance and repair performed by motor carrier owners, which may have an interest in better maintenance control on their own equipment as IEP. • **Other:** Exporters may benefit by being able to re-load containers recently made empty without having to pull empty equipment from terminals.	• **Service Risk**: Less practical for wheeled terminals, as chassis flip could lead to service delays. Also, potential for increased inspection (e.g., at terminal) could lead to delays. • **Service Terms**: Increased coordination challenge with motor carriers at drop and hook facilities (increase challenge to ensure right chassis with right motor carrier).

5.2.3 BCOs and Chassis Supply Transitions

All BCOs surveyed were aware of the changing landscape with regard to chassis in the intermodal supply chain. In every case, the status quo chassis supply model was preferred to any alternative, which is not surprising given the specific BCO interests and their current chassis supply arrangements—minimum or otherwise understood service risk, good service terms, and no separate explicit cost.

Nevertheless, nearly all BCOs consulted have had a dialogue with at least one ocean carrier partner and motor carriers regarding new chassis paradigms. As a result, shippers are starting to prepare for constructive engagement with the other stakeholders—ocean and motor carriers—regarding potential necessary commercial and operational changes.

Of the many concerns BCOs might have regarding this fundamental adjustment to their logistics structure, not surprisingly, the two highest rated in our surveys were the level of service and potential cost impacts, which were rated as roughly equal. Other factors including quality and safety (maintenance and repair) were ranked in the middle, with liability the lowest-rated concern. These results correlate well to the level of visibility each factor has with BCO supply chain managers. Cost and level of service are universally the top issues for all transportation purchasers; chassis-related liability has not traditionally been managed by shippers, but depending on future chassis supply strategies, may become of increased concern.

Of note, nearly all the BCOs surveyed utilized drop and hook container operations, which has historically included "free time" at their facilities (though arguably had a cost associated with it buried in the freight rate). Should the introduction of new chassis supply arrangements include a separate and daily chassis rental rate, this would explicitly price the cost of drop and hook operations and related chassis time at the shipper's facility. However, the BCOs consulted indicated that their current logistics arrangements are predicated on the drop and hook chassis supply model and that the introduction of chassis costs alone may not be reason enough to change this arrangement. One exporter that currently has chassis free time in excess of 10 days, however, is considering a change in its logistics pattern to reduce its exposure to potential chassis charges in a daily rate scenario.

Another BCO indicated that transload operations may be considered in the future if chassis charges and arrangements become onerous, indicating that a transload operation could result in faster ocean chassis cycle times as operations are typically located close to port terminals. Likewise, some large BCOs operate private trucking fleets and have significant asset management experience and may opt to change or modify supply chains to respond to changes in chassis supply terms.

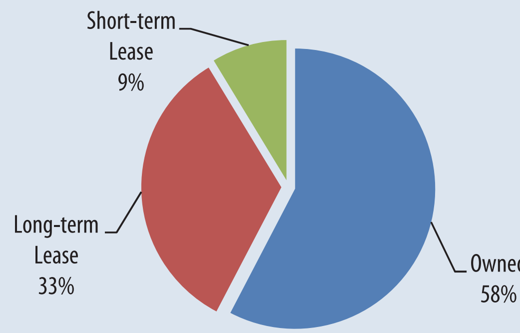
In any case, it is likely that the discontinuance of the ocean carrier chassis supply model will have implications for BCOs (in particular as related to chassis charges and potentially service levels), although it is too early to assess the degree of these potential implications. In the short term, BCOs consulted indicated that evolving chassis supply models and their implications would have limited impact on their supply chain practices. For example, if a BCO has a drop and hook operation or a live-unload operation, it has indicated that these practices will likely be maintained for the utility they provide to the BCO's supply chain, even if a separate chassis charge was being applied.

5.3 Ocean Carriers

In almost all markets in the U.S., chassis supply has historically been the responsibility of the ocean carrier. Most ocean carriers considered providing chassis a cost of doing business in the U.S., the equivalent of providing containers. Chassis management became its own operational unit for ocean carriers, requiring staff and systems for logistics and maintenance. However, often these costs were considered "fixed," akin to the vessel or container assets, and were not reflected in the net revenue contribution analysis. Despite the desire to exit the chassis supply business, the container shipping supply chain has developed around ocean carrier ownership and operations in the U.S. How the ties are severed and reconfigured in a way that does not unduly disrupt the supply chain flow is at the heart of the strategies carriers are employing to transition chassis models.

Profile of Ocean Carriers Consulted

Ten major ocean carriers were consulted in the development of this Guidebook, collectively serving all major U.S. container ports. In total, this group operates over 150,000 ocean container chassis, representing more than a quarter of the U.S. ocean container chassis fleet. The proportion of owned versus leased chassis differs by ocean carriers—in most cases, carriers consulted own more chassis than they lease, although the reverse is true of at least one consulted ocean carrier. On average close to 60% of chassis operated by those consulted are owned, as summarized in the adjacent pie chart.



Other characteristics of the sample of ocean carriers consulted include the following:

- 70% of the ocean container traffic handled at U.S. ports was merchant haulage (30% carrier haulage).
- These ocean carriers did not own or operate specialty (e.g., tri-axle) chassis.
- They have not purchased chassis recently or in any great quantity—no new marine chassis purchases since 2008, average last purchase date in 2006, last major purchase (>10% of total fleet) was in 2003, size of purchases declined each year.

5.3.1 Commercial Needs and Interests vis-à-vis Chassis Supply

The ocean carrier's need for chassis is determined by its commercial strategies, its operating environment, and its customers' logistics requirements. Wheeled marine and rail terminals, extra free time provisions, and customers' drop and hook delivery needs locations are key factors that increase the demand for chassis supply. Also, ocean carriers have differing attitudes towa rd chassis ownership. Some have historically preferred ownership of assets and operating control; others prefer the flexibility of leasing assets and utilizing neutral chassis pools to avoid the long-term commitment of ownership.

In any case, from an ocean carrier perspective, the primary interests with respect to chassis are the following:

- **Capital costs/lease rates:** The cost of purchasing/owning/replacing chassis and related financing costs (when owned by ocean carrier), or lease rates, when leased.
- **Operating cost:** Maintenance and repair costs, administrative costs, cost of storage, handling, and repositioning costs.
- **Adequacy of supply:** Right number of chassis in the right place, at the right time.

- **Asset utilization:** The higher the better, leading to more effective chassis cost per load.
- **Liability:** Chassis provider is responsible to provide adequate third-party liability insurance.
- **Service offering:** Potential commercial differentiator when chassis provided as part of service.

Ocean Carrier Performance Metrics with Respect to Chassis Supply

By and large, the chassis is tracked insofar as it is a cost to ocean carriers with chassis utilization the secondary consideration (compared for instance with ocean vessel utilization, which is of greater concern). Dwell time and total turn-time are used, but more as a metric for containers. Other chassis supply factors are tracked or captured in terms of services with BCOs, but not necessarily tracked using specific metrics.

5.3.2 Advantages and Disadvantages of Alternative Chassis Supply Models for Ocean Carriers

From the perspective of the ocean carriers, the advantages and disadvantages of alternative chassis supply models are presented in Table 5-2, with a focus on the implications to their specific commercial interests, as outlined in Section 5.3.1 above.

Table 5-2. Advantages and Disadvantages of Alternative Chassis Supply Models from the Perspective of Ocean Carriers

Chassis Supply Model	Advantages	Disadvantages
(Conventional) Ocean Carrier Chassis Model	• **Service Offering:** Potential commercial differentiator when chassis provided as part of service. Highest operating control by the ocean carrier.	• **Capital Cost:** Chassis capital costs borne by ocean carriers or lessors. With respect to ownership by the ocean carrier, a disadvantage is that the carrier must pay capital cost and related storage fees, among others, even when the chassis are not needed and used. • **Operating Cost:** All costs associated with chassis supply, including maintenance and repair, administration, repositioning between or within regions/locations, and so forth borne by ocean carriers or lessors. • **Adequacy of Supply:** More difficult to manage and balance supply relative to pool models, which aggregate and balance supply more easily. • **Asset Utilization:** In general lower utilization than pools, which aggregate multiple chassis fleets to supply multiple ocean carriers. • **Liability:** Ocean carrier is responsible to provide insurance.
National / Regional Cooperative (Co-op) and Alliance Co-op Chassis Pool Model (**Note:** some terminal pools are neutral and some are co-op.)	• **Service Offering:** As in ocean carrier chassis supply model. • **Asset Utilization:** Improved asset utilization (compared to ocean carrier model). • **Liability:** Improved insurance regime and lower insurance cost (through collective approach). • **Other:** More uniform maintenance and repair practices (versus individual ocean carrier model).	• **Capital Cost:** Does not achieve divestiture of chassis assets. • **Operating Cost:** Operating costs ultimately borne by the individual ocean carriers that have contributed to the chassis pool. • **Other:** Required collective decision making causes slower reaction time, some member dissatisfaction with decisions, and optimization of the "whole" at the expense of the individual lines.

Neutral Chassis Pool Model (**Note:** some terminal pools are neutral and some are co-op.)	• **Capital Cost:** No chassis-related capital investment needed for ocean carriers. • **Operating Cost:** Reduced administrative expenses for ocean carriers. • **Adequacy of Supply:** Can move quickly to right-size pool due to single fleet/management structure and large fleet structure of leasing companies (compared to co-op pools, which require cooperative decision making, or ocean carrier model, in which ocean carrier may not be able to quickly inject supply during peak needs). • **Liability:** Ocean carrier is not the chassis provider in this model, and has lower liability risk compared to ocean carrier/co-op chassis supply models. • **Other:** -Transfers cyclical and structure asset risk to pool asset provider (though user will pay higher per diem for over-utilization and potentially under-utilization as well). -Ocean carrier not responsible for long-term supply .	• **Operating Cost:** Highest per day chassis per diem lease fees. • **Other**: Single-supplier risk of increasing cost over time (due to lack of competition).
Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Model	• **Capital Cost**: No chassis-related capital investment needed by ocean carrier. • **Operating Cost**: Reduced direct chassis-related expense, and related administrative expense for ocean carrier. • **Liability:** No direct liability under the federal roadability regulations, but depending on motor carriers' insurance program may face increased risk compared to pool models. Reduced third-party insurance against the chassis operation.	• **Chassis Charges:** Chassis "cost" control lost; subject to incur increased expense (via motor carrier) or lower revenue (commercial concessions to customers). • **Service Offering:** Ocean carriers lose control over reliability of chassis supply, if completely motor carrier provided. • **Other**: Incompatibility with wheeled terminals complicates transition.

5.3.3 Ocean Carriers and Chassis Supply Transitions

According to the OCEMA website, 16 ocean carriers have implemented chassis model transitions of some type. Most have ended the general practice of providing chassis in smaller container volume markets though a few lines have implemented transition strategies in major markets as well. As of February 1, 2012, only two ocean carriers, Maersk and CMA CGM, have implemented national programs to transition chassis models. However, APL, one of the largest lines to remain quiet on the issue, recently announced plans to exit the chassis supply business.

While the ocean carriers recognize there would be revenue and drayage rate trade-offs in exchange for elimination of the direct chassis expense, our consultations with ocean carriers indicate that ocean carriers are targeting a 50% net savings during the transition phase nonetheless. Savings for ocean carriers do not automatically mean expense for other stakeholders, as the ocean carriers expect that operating efficiencies executed by all stakeholders may drive financial waste out of the system.

As the process is unfolding among the ocean carriers, certain challenges in transitioning chassis models are emerging. These issues are in general applicable to most, though not all, ocean carriers, but as a group are affecting the speed of execution:

Disposition of Owned Assets

Even with the sale of Maersk's chassis (DCLI), an estimated 175,000 chassis are still owned by ocean carriers. The model of asset disposition remains a big question. As one ocean carrier put it:

> If today I could find a buyer for my chassis, I would opt out tomorrow. Where the book value is very high, it's hard to get out though; only low book value ones can be sold in large quantity.

Chassis sales from ocean to motor carriers has occurred in very limited quantities compared to the existing potential supply, and sales to brokers often result in chassis being repositioned to non-U.S. markets. There are also potential opportunities for creating chassis leasing businesses, which will draw private capital into the market, as was recently done with sale of DCLI.

Commercial Considerations/Requirements by BCOs

Prior to selling assets, the ocean carriers have to overcome the commercial pressure from customers who will resist change to the status quo. Underpinning this resistance is the larger issue of vessel capacity demand/supply forces that drive service contract negotiations. Internally within the ocean carrier business, there is a natural tension between the operations function, which is pushing this change to obtain cost savings, and the sales function, which is responding to customer pressure not to change.

A related major concern expressed by ocean carriers, once they relinquish control over chassis, is whether the market will ensure there is adequate supply as container growth resumes, or chassis replacement is required. Any transition moving toward a lower level of service or a more unreliable supply of chassis may cause some reconsideration of the approach.

5.4 Motor Carriers

The motor carrier drayage model in the U.S. container trade is predominately "asset light," utilizing primarily owner-operators (aka "sub-contractors") to provide drayage services, without investments in trucks, chassis or storage land. However as the costs of trucking and regulatory scrutiny increase, many drayage firms are hiring more company drivers and larger carriers are expanding into the port services area. In any case, there are over 6,000 drayage companies registered with Intermodal Association of North America's "Uniform Interchange Intermodal Agreement." In the U.S. chassis system, the motor carrier is in a unique position because it is the stakeholder that handles the asset the most, yet, in general, has the least amount of control over it. Other stakeholders establish the "rules" of chassis usage and the motor carrier in turn must play by them.

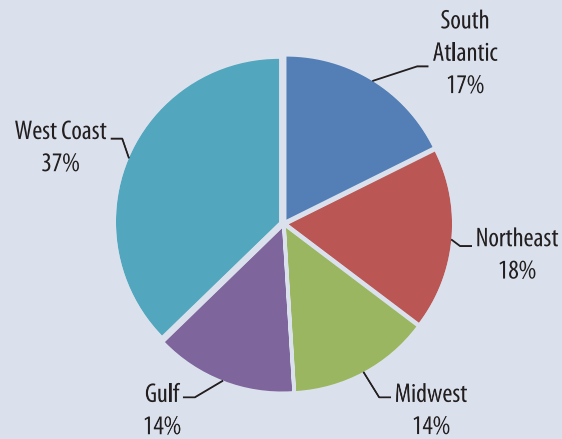
There are four key factors controlled by other stakeholders, which have a direct impact on drayage productivity with respect to chassis:

Factor	Primary Influencer
Wheeled vs. grounded terminal	Marine/rail terminal
Chassis supply	Ocean carrier/neutral pool operator/terminal pool operator
Chassis condition	IEP
Inspection and maintenance of chassis	Terminal operator/ocean carrier/union

The motor carriers' challenge is to maximize operating efficiency while navigating the rules of the game that traditionally have been different by ocean carrier, by terminal, and by geography. Up until the ocean carriers started to transfer their responsibilities for chassis supply, the rules for chassis had been fairly stable. Now that most of the ocean carriers have implemented some form of chassis usage or expense-shifting program, and that many of these programs are again unique by line, terminal, and geography, the transition for the motor carrier involvement for chassis responsibility is complex.

Profile of Motor Carriers Consulted

Thirty motor carriers were consulted in the preparation of this Guidebook, collectively serving all major ocean and inland rail terminals in the U.S. The adjacent figure provides an overview of regions served by the sample of motor carriers consulted. It should be noted that certain motor carriers consulted serve a very limited geography (e.g., 150 to 200 mile radius of the ports of New York and New Jersey), whereas others indicated that they served nearly all major U.S. regions.



In terms of drayage activity, the motor carriers consulted cumulatively make approximately 70,000 drayage moves per week, ranging from 30 moves per week for a smaller carrier, to over 13,000 moves per week for a larger carrier. The majority of these motor carriers use owner-operators, under sub-contract, for ocean container drayage services. Only a few of the motor carriers consulted owned and operated their own chassis.

With respect to delivery of containers to shipper facilities, there was a significant range of live-unload vs. drop and hook services by motor carriers, although on average, drop and hook service was most typical (62%) vs. live-unload (38%).

5.4.1 Commercial Needs and Interests vis-à-vis Chassis Supply

The economics of the U.S. marine drayage business is based on maximizing the number of truck trips daily, since drayage rates, and driver compensation, are move-based. The motor carrier industry is highly sensitive to any operational or commercial factors that cause idle time while the driver is working within his/her hours of service schedule. Turns (trips) per day and minimizing terminal dwell time were the two most important productivity measurements cited in our motor carrier survey responses.

For the most part, the commercial needs and interests of motor carriers vis-à-vis chassis relate to the potential impact of the chassis or chassis supply on the motor carrier productivity (number of turn trips and terminal dwell times).

Chassis-related factors influencing productivity include whether chassis are stored on the terminal or off the terminal, whether the terminal operation is wheeled (requiring chassis flips under this model) or grounded, inspection, and over-the-road repair, among others.

The following are other commercial factors, currently of less immediate concern to motor carriers given the current U.S. chassis supply environment, but that could become much more important as chassis models evolve:

- **Capital Cost**: Any capital costs associated with purchasing/owning/replacing chassis and related financing costs.
- **Operating Costs/Lease Rate**: Direct operating costs associated with owned chassis including maintenance and repair, administration, and so forth, or chassis lease rates.
- **Liability**: Cost of purchasing third-party liability insurance, if chassis owned, or otherwise risk equipment breakdowns or failures if third party supplied.
- **Safety and Regulation**: Minimizing roadability repairs, and violations. In an environment of increased regulatory scrutiny created by the FMCSA, roadability concerns and the risk of being stopped for equipment safety violations is of critical concern.

- **Supply**: Ensuring adequate supply of chassis—right place at the right time.

Motor Carrier Performance Metrics with Respect to Chassis Supply

Motor carriers were typically less inclined to measure chassis performance given they are still typically not paying this cost, and ownership rates are very low. The utilization of their drivers and tractors is more pressing. Where they do own chassis (e.g., specialty tri-axle chassis), maintenance and repair costs and related metrics (e.g., maintenance and repair costs per day) are unsurprisingly the largest cost.

Another significant metric for motor carriers is the damage expense charged to them during chassis operation. The largest share is repair costs incurred during transportation, when a chassis component, typically tires, fails and must be immediately repaired. The other case is when in-gate inspections of chassis returned to terminals have identified damage as defined under contract or regulation, and the cost to repair is billed back to the motor carrier.

5.4.2 Advantages and Disadvantages of Alternative Chassis Supply Models for Motor Carriers

From the perspective of the motor carriers, the advantages and disadvantages of alternative chassis supply models are presented in Table 5-3, with a focus on the implications to their specific commercial interests.

Table 5-3. Advantages and Disadvantages of Alternative Chassis Supply Models from the Perspective of Motor Carriers

Chassis Supply Model	Advantages	Disadvantages
(Conventional) Ocean Carrier Chassis Model	• **Capital Costs:** No capital investment required for chassis or chassis storage. • **Operating Costs**: Not borne directly by motor carrier. • **Maintenance and Repair Costs:** No maintenance cost (other than for identified damage attributed to the motor carrier). • **Other:** Does not constrain ability to grow truck fleet base.	• **Productivity:** Different chassis-related policies, that is, maintenance and repair and free time rules to manage with each ocean carrier. • **Supply:** Reliant on third parties to ensure adequate supply, proper maintenance, and chassis handling, including gate inspections. • **Other:** Having multiple points of contact—one for each line—for chassis supply and maintenance issue increases complexity of business rules and adds administrative costs.
National/Regional Cooperative (Co-op) and Alliance Co-op Chassis Pool Model	• **Productivity:** Tends to reduce delays for flips on mismatched chassis/containers (compared to ocean carrier model). Less complexity (relative to ocean carrier model) with respect to rules and points of contact. • **Capital Costs:** No capital investment required for chassis or chassis storage. • **Operating Costs**: As above, not borne directly by motor carrier. • **Liability:** Liability and third-party insurance cost not borne by motor carrier. • **Other:** Does not constrain ability to grow truck fleet base.	• **Supply:** Reliant on third parties to ensure adequate supply, proper maintenance, and chassis handling, including gate inspections.
Neutral Chassis Pool Model	• **Productivity:** "Gray fleet" increases efficiency when it serves multiple terminals due to more "start" and "stop" locations. • **Capital Costs:** No capital investment required for chassis or chassis storage. • **Operating Costs**: Maintenance, repair, administration costs not borne directly by motor carrier, unless damage attributed to motor carrier. • **Liability:** Liability and third-party insurance cost not borne by motor carrier. • **Other:** Does not constrain ability to grow truck fleet base.	• **Supply:** Reliant on third parties to ensure adequate supply, proper maintenance, and chassis handling, including gate inspections • **Operating Costs**: Highest per diem chassis lease rate.

Terminal Chassis Pool Model	• **Productivity:** "Gray fleet" increases efficiency when it serves multiple terminals due to more "start" and "stop" locations. • **Capital Costs:** No capital investment required for chassis or chassis storage. • **Operating Costs**: As above, not borne directly by motor carrier, unless damage attributed to motor carrier. • **Liability:** Liability and third-party insurance cost not borne by motor carrier. • **Other:** Does not constrain ability to grow truck fleet base.	• **Supply:** Reliant on third parties to ensure adequate supply, proper maintenance, and chassis handling, including gate inspections. Less operational flexibility since chassis constrained to the terminal's customers.
Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Model	• **Grounded Terminals:** At grounded terminals, less terminal time in chassis inspection, handling, and repair; improved driver productivity. • **Safety and Regulation:** Ability to control maintenance quality and thus cost and productivity; minimize incidences of bad-order chassis. • **Other:** Ability to differentiate product especially in low-density geographic regions where chassis supplies can be short. • **Productivity:** With a growing demand for exports in many regions, keeping the chassis off terminal could allow motor carriers to minimize miles between inbound and outbound loads.	• **Productivity:** Potential for increased transit miles with bare chassis (if loads unbalanced), depending on the operation at the terminal and the market balance in the region. • **Wheeled Terminals:** Motor carrier model requires chassis flip at wheeled terminals, which may lead to delays, increased turn times, and so forth. • **Capital Cost:** Chassis and infrastructure (storage) capital investment requirements to be borne by motor carrier. Need to obtain land for storage and M&R, or pay third party for it. • **Operating cost:** Maintenance and repair, administration (increased staff to manage and maintain chassis; invoice and collect chassis charges). Managing chassis utilization as a capital asset increases business complexity. • **Liability:** Liability and third-party insurance to be borne by motor carrier. • **Other:** Potential additional chassis inspections by terminal labor could lead to redundancy, delays , and lower productivity.

From a motor carrier perspective, the co-op pool was a big efficiency improvement over the traditional ocean carrier–controlled model due to the flexibility to drop off chassis at more terminals covered by the pool, as well as the big decreasein chassis flips caused by terminal mismatches of containers and chassis.

Motor carriers also favored chassis pools, such as neutral and terminal pools. However, many did not fully understand the constructive differences between co-op, neutral, and terminal chassis pools, but tended to refer to chassis pools generically as "neutral pools." The researchers believe this is a reference to the chassis as a "gray" asset, which is how the motor carrier derives the majority of its efficiencies. As one motor carrier put it:

"A gray fleet in a cooperative-type chassis pool. It gives me the flexibility to pick up any chassis and not worry."

5.4.3 Motor Carriers and Chassis Supply Transitions

Approximately 85% of the motor carriers surveyed still are unsure of their chassis strategies or are passively awaiting the market to sort it out. Nevertheless, the potential implications of chassis supply transitions from the motor carrier perspective are many. Among the key considerations are the following:

Chassis Lease Charges

Motor carriers are concerned their costs will be impaired if the chassis supply transition necessitates renting chassis daily through chassis pools. The three highest related concerns among those motor carriers consulted were potential challenges to recoup these costs, the increasing lease rates offered by the neutral pool operators, and the lack of supplier choice for some of the chassis pools (i.e., limited competition among chassis providers).

Chassis Flips at Wheeled Terminals

A motor carrier bringing its own chassis into a wheeled terminal may incur an additional wait to move the container from the chassis on which it is resting in the terminal to that of the motor carrier, endangering appointments and running down the hours of service clock. The cost of the chassis flip would be borne by the motor carrier.

Chassis Delivery and Pickup Logistics

At many shipper facilities multiple motor carriers are requested to drop a full container and pick up an empty one. This could create billing accuracy and chassis accountability challenges (if, for example, motor carrier A drops off chassis A, but returns with chassis B, controlled by motor carrier B).

Cost of Capital and Operating Costs (If Chassis Purchased)

Should motor carriers purchase their own ocean container chassis, this would lead to higher capital and related financing costs, which for smaller players may be prohibitive. There would also be a number of operating costs, including, in particular, maintenance and repair costs, not currently incurred directly by most motor carriers for ocean container chassis.

Potential for Redundancy in Chassis Inspection

Some motor carriers have expressed a concern about the potential for redundancy in chassis inspections, where inspections may occur off the terminal, and may be inspected again by terminal labor, which could lead to added delays and lost productivity.

Storage

The majority of motor carriers surveyed listed parking and storage requirements as the major hurdle to chassis ownership, second only to capital cost and ahead of maintenance requirements and all management and utilization concerns. Indeed 90% of all motor carriers, including every one operating over 10,000 moves per week, said that they would need to acquire more land to transition to a full motor carrier model.

5.5 Terminal Operators (Marine and Inland)

Terminals, both marine and rail, are the place where the container in transit changes transportation modes. Chassis are used at terminals to support drayage operations, for internal terminal operations (moving containers within the terminal), and in storage (particularly the case for wheeled terminals). When not in use at terminals, chassis are stored, typically on site in stacks, racks, or simply parked, as described in Chapter 2. Marine and rail terminals in the U.S. have developed terminal infrastructure and operating practices around ocean carrier chassis domiciled on-property.

Profile of Terminal Operators Consulted

Fourteen major terminal operators and port authorities were consulted in the preparation of this Guidebook, of which seven were marine terminal operators, five rail terminal operators, and two operating port authorities. From a geographic perspective, all major U.S. marine terminals were covered. In terms of rail terminals, representatives from five major railways were consulted.

5.5.1 Commercial Needs and Interests vis-à-vis Chassis Supply

Though terminal operators seek to optimize the profitability of their system, they must also consider the requirements and needs of their customers and stakeholders (motor carriers, shippers, and unions), which may influence operating processes.

For the most part, terminals rely on ocean carriers provisioning and managing chassis to sufficient quantity and quality to operate effectively and efficiently. Most rules governing chassis on-terminal are contained in the commercial contract between the terminal operator and ocean carrier or pools, though some provisions such as storage and maintenance may be contained in general tariffs.

From a terminal operator's perspective, the primary interests with respect to chassis are the following:

- **Terminal Productivity**: Maximizing terminal throughput and using terminal assets, including land and equipment, efficiently. This includes eliminating/minimizing/reducing handling and processes of containers and chassis, maximizing labor, yard, and handling equipment productivity, and maximizing land-use productivity.
- **Supply**: Ensuring an adequate supply of chassis for efficient terminal operations and to minimize chassis flips.
- **Chassis Storage Footprint**: The physical terminal space utilized for chassis storage, which cannot otherwise be used for container storage or other terminal operations (related to land-use productivity).
- **Capital Cost**: Any capital costs associated with purchasing/owning/replacing chassis and related financing costs.
- **Operating Costs**: Costs associated with chassis maintenance and repair and chassis administration (when chassis owned and supplied by terminal).

Based on the researchers' discussions with the largest marine and rail terminal operators in the U.S., it was found that their highest priorities for chassis are to have sufficient quantity so as not to delay container handling operations, and that they be well maintained to avoid repairs after being matched to a container and truck, thereby minimizing the need for chassis flips. Also, terminals tend to prefer minimizing the footprint of chassis on terminal sites, given that this space cannot be otherwise used for container storage or other terminal operations.

Terminal Operator Performance Metrics with Respect to Chassis Supply

Since chassis are the conveyance equipment to deliver and receive containers, and in the U.S. system supply is generally maintained on-terminal, terminal operators possess a keen interest in certain performance indicators. However, apart from the cases of terminal-operated chassis pools, they are not as inclined to be concerned with utilization rate so much as cost control and supply liquidity. The primary metrics used by terminal operators and port authorities with respect to chassis are varied and often inconsistent, but include share of total land devoted to chassis storage; percentage of bad-order chassis; and administrative cost and maintenance and repair costs, as applicable.

5.5.2 Advantages and Disadvantages of Alternative Chassis Supply Models for Terminal Operators

From the perspective of terminal operators (rail and marine), the advantages and disadvantages of alternative chassis supply models are presented in Table 5-4, with a focus on the implications for their specific commercial interests.

Table 5-4. Advantages and Disadvantages of Alternative Chassis Supply Models from the Perspective of Terminal Operators

Chassis Supply Model	Advantages	Disadvantages
(Conventional) Ocean Carrier Chassis Model	• **Capital Costs:** No capital investment required for chassis by terminals. • **Operating Costs**: Costs associated with chassis maintenance and repair and chassis administration not borne by terminal operators. • **Other:** Direct contractual relationship between ocean carrier and terminal improves supply coordination and responsibility.	• **Terminal Productivity**: Highest mismatch potential for wheeled operations—requiring chassis flips, which leads to delays, inefficiencies. Also, coordinating maintenance regimes with each line is inefficient. • **Chassis Storage Footprint:** Largest footprint for ocean carrier chassis model, particularly in wheeled terminal operations. • **Supply:** Managing supply sufficiency for each line is a challenge (more so than for co-op and other pool models).
National/Regional Cooperative (Co-op) and Alliance Co-op Chassis Pool Model	• **Terminal Productivity:** Higher chassis utilization than ocean carrier model, enabling fewer chassis to be stored on terminal. • **Supply:** Chassis supply is generally better than in ocean container model. "Gray fleet" eliminates chassis flip caused by mismatching containers to chassis, although flips may still be required for damaged chassis, etc. • **Chassis Storage Footprint:** Lower chassis storage footprint than in ocean carrier model. • **Capital Costs:** No capital investment required for chassis by terminals. • **Operating Costs**: Costs associated with chassis maintenance and repair not borne by terminal operators. Decreased administration of chassis through a single point of contact for supply, logistics, and management. • **Capital Costs:** No capital investment required for chassis by terminals.	• **Other:** Need to develop third-party contractual relationship governing chassis rules.
Neutral Chassis Pool Model	• **Advantages as in co-op model above.** • **Chassis Storage Footprint:** Lower chassis storage footprint than in ocean carrier model.	• **Cost:** If neutral pool is controlled by for-profit third party, potential for neutral pool chassis cost increases to become commercial issue for terminal. • **Other:** Need to develop third-party contractual relationship governing chassis rules.

Terminal Chassis Pool Model	• **Terminal Productivity:** Higher chassis utilization than ocean carrier model. Gray fleet eliminates chassis flips caused by mismatching containers to chassis. Potential for fewer flips with terminal-managed chassis fleet. • **Supply:** Because the terminal operates the pool, it has the highest degree of control to adjust to cyclical or structural demand. • **Chassis Storage Footprint:** Lower chassis storage footprint than in ocean carrier model. • **Other:** Integration of terminal management and chassis management could lead to greater terminal efficiencies.	• **Capital Costs:** Capital investment in chassis borne in full or in part by terminal operators. • **Operating Costs**: Costs associated with chassis maintenance and repair borne by terminal operators. • **Other:** Not effective if multiple terminal pools serve a region, as this would effectively recreate multiple chassis fleets at a terminal.
Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Model	• **Terminal Productivity:** Faster gate inspections by not inspecting chassis (chassis considered by the terminal to be an extension of the truck, thereby not requiring specific chassis inspection). • **Chassis Storage Footprint**: Increases terminal capacity by eliminating dedicated chassis storage areas and reducing motor carrier dwell time caused by pre-exit chassis repair or flip. • **Capital Costs:** No capital investment required for chassis by terminals. • **Operating Costs**: Costs associated with chassis maintenance and repair not borne by terminal operators.	• **Wheeled terminals:** Problematic at wheeled terminals (requires a chassis flip). • **Supply:** Terminals cannot hold their customers accountable for chassis supply.

Of the terminals consulted, even those operating in a partial wheeled environment, the motor carrier supply model was deemed the "long-run solution." The following is a selection of related comments from terminal operators:

"May need longer truck queue as all trucks will come in with chassis, instead of just tractors. However, inside terminal there will be more space. There will be faster truck turn-time at the terminal due to no time to obtain and inspect chassis by the drivers. "

"A pure trucker wheel environment would provide a substantial increase in terminal productivity."

"A trucker model holds the most promise in my mind. It gets the assets off the terminal and they are better controlled and maintained."

5.5.3 Terminals and Chassis Supply Transitions

Though marine terminals prefer the motor carrier owned/operated model, which would effectively move the chassis storage terminal, none surveyed believed transition to this model was realistic in the short term, as the barriers to wholesale change are too numerous and too high to undo the current chassis structure. These factors have been described previously, but include the many challenges in the transfer of assets from ocean to motor carriers (capital, storage facilities, maintenance, and administration), the conversion from wheeled to grounded operations, commercial free time, and drop and hook delivery logistics.

5.6 Other Chassis Stakeholder Perspectives

5.6.1 Leasing Companies

The business structure built by the leasing companies is quickly changing. The decades-old chassis leasing business model of high percentage of revenue derived from long-term leases is less sustainable in the current market flux, as customers are shunning long-term or master lease commitments in favor of chassis pools.

In the immediate future, the leasing companies see chassis pools growing, and triple-net lease business shrinking in their revenue profile. While term leasing to motor carriers is on the rise, it is not seen as coming close to compensating for the reduction from ocean carriers.

5.6.2 Labor Unions

Labor unions have had a significant interest in evolving chassis supply models. For example, at the March 2012 *Journal of Commerce*–sponsored Transpacific Maritime Conference, the spokesman for the ILA, which has jurisdiction for U.S. East Coast ports, identified four essential issues that would need to be resolved in this year's contact negotiations. These issues included (1) automation, (2) jurisdiction, (3) chassis, and (4) overweight containers. The ILA prefers jurisdiction over chassis maintenance and are particularly concerned with how evolving chassis supply models may impact employment.

6 Implications of Evolving Chassis Supply Models for Public Policy and Planning Organizations

Key Messages

- From an operational perspective, **public agencies have limited direct influence over how chassis supply models will evolve**—this will largely be determined commercially among supply chain actors.
- Nevertheless, the implications of consequence to public policy and planning organizations include the **potential for increased truck movements on roads** to reposition, pick up, or drop off chassis; greater pressures on intermodal connectors, and increased land footprint requirements for storage. Other potential impacts within the purview of the public transportation oversight community are a host of **externalities, including road congestion, pollution, road safety issues, and land-use challenges**.
- **It is not the alternative chassis supply model, per se, that will directly influence increased truck moves/miles.**
- The most important off-terminal land-use implications with respect to evolving chassis supply models concern **chassis storage location**.
- **Intermodal terminals, markets, and volumes vary significantly by geography**; each planning entity should strive to understand its unique catchment areas and market drivers that will influence future chassis supply in the region.

6.1 Public Policy and Planning Organizations

Public policy and planning organizations, including federal and state transportation departments, municipal planning organizations (MPOs) and port authorities are important stakeholders in the evolution of chassis supply models. Each level of government and organization has different mandates and jurisdictional authorities, but they have a common mission to provide for the public wellbeing and to promote economic development and regional competitiveness. This is achieved through planning and investment in public transportation infrastructure, including highways and intermodal connectors, safety, environmental and other regulations and land-use planning.

Profile of Public Policy and Planning Organizations Consulted

Seventeen public policy and planning organizations were consulted in the preparation of this Guidebook, including five state departments of transportation (DOTs), eight MPOs and chambers of commerce, and four port authorities. It should also be noted that many state DOTs reached out to MPOs within their state to assist in the development of a comprehensive response. The U.S. Chamber of Commerce and other federal transportation agencies were also contacted about their understanding of the changes in chassis provisions.

Public agencies were selected based on geography, scale, and demonstrated expertise in freight planning and innovation. Public organizations consulted represent coastal and gateway cities, large and small, north and south, and urban and suburban agencies.

The level of understanding of the evolving chassis landscape in the U.S. varied. Only one respondent indicated a very good understanding of evolving chassis issues (a port authority, the closest stakeholder to the issue); two responded indicating no understanding of chassis issues at all (state DOTs), and others were generally in between although skewed toward a lesser understanding. One thing is clear: evolving chassis supply issues in the U.S. are not universally well understood by public policy and planning organizations.

6.2 Implications of Evolving Chassis Supply Models for Public Policy and Planning Organizations

The public policy and planning implications of evolving chassis models could include the potential for increased truck movements on roads to reposition, pick up, or drop off chassis and greater use of intermodal connectors, and increased land-footprint requirements for chassis storage. Other potential impacts within the purview of the public transportation oversight community are a host of externalities, including road congestion, pollution, road safety issues, and land-use challenges, resulting from increased truck moves/miles. It is, however, not possible to predict the extent of these impacts as future chassis supply models and related chassis storage approaches remain in a state of flux.

Public agencies have limited direct control over how chassis supply models will evolve—this will largely be determined commercially among supply chain actors. Nevertheless, the role of public policy and planning organizations can have an influence on evolving chassis supply models.

The influence of each level of government and the potential implications of evolving chassis supply models are outlined below.

Federal Level

At the federal level, safety is a paramount concern. Legislation and rulemaking concerning equipment maintenance and roadability have been enacted, requiring equipment safety checks at intermodal interchange points. The federal government also administers the Highway Trust Fund and investments in National Highway System intermodal connectors, which could be affected by evolving chassis supply models if these lead to increased truck moves.

State Level

State involvement in international freight movement includes corridor planning, freight system network performance assessment, and highway and roadway funding for connections to the private freight networks. If a change in chassis supply affects the overall highway congestion due to additional truck trips or equipment shuttling between off-terminal equipment depots, state and local planning agencies will be obligated to address increased maintenance and capacity needs. These agencies may consider user fees, taxes, permits, or other revenue-generating mechanisms to fund necessary improvements. Conversely, if congestion can be mitigated and truck trips reduced via chassis configuration, policy makers need to be aware of potential strategies.

States surveyed have an overall interest in freight center development and measure volumes in aggregate. They typically rely on MPOs and logistics firms to assess local performance. While most states do not identify chassis issues on an individual basis, they recognize growing trucking activity, and the related role of the chassis, in support of international trade.

Metropolitan Planning Organization Level

Metropolitan planning organizations (MPOs) and economic development organizations have interests in local community infrastructure and economic development. Their direct responsibility for freight includes the development of planning documents. The Transportation Improvement Plans (TIPs) must be completed every 4 to 5 years and include local project selection, strategies, and short-term priorities for funding by the MPO. The statewide TIP will incorporate the TIPs of various MPOs into the statewide program by reference, and will also incorporate projects within the state falling outside of any specific MPO. MPOs are typically concerned with the development of freight performance measures, the condition of National Highway System (NHS) intermodal connectors, and truck parking and congestion strategies to mitigate environmental concerns. Economic development agencies are also locally focused and concentrate on developing and retaining local business and job creation.

Among the MPOs surveyed, there was a general trend to define intermodal more broadly to include containers as well as transload and bulk material handling facilities. MPOs in larger urban areas are concerned with any changes in truck-related traffic and tend to focus on operations and performance measures. Land use is a key issue voiced by many with interest in developing freight villages or clusters to keep freight concentrated. Changes in the number of chassis movements to or from freight terminals and equipment depots would affect all these measures and local planning.

Port Authorities

Port authorities are public entities that operate in one of two models—as a landlord port or as an operating port. The landlord port is responsible for capital improvements and leases out the terminal to operating companies. These leases can specify environmental restrictions and terminal use provisions. Operating ports provide capital for improvements and also take an active role in the daily operation of the port.

The Port Authority of New York/New Jersey, Ports of Long Beach and Los Angeles, the Port of Oakland, and the Port of Seattle are examples of landlord ports that have long-term contracts with terminal operators such as Ports America, SSA, ITS, and Maher Terminals. The Port of Virginia, the South Carolina State Ports Authority (Charleston) and the Georgia Port Authority (Savannah) are examples of operating ports in which public authorities (or those governed by public authorities) own the assets and provide and manage the labor to operate the marine terminals.

Port authorities—landlord as well as operating—are engaged in internal discussions regarding chassis model alternatives and potential impacts to the terminals. Operating ports are directly involved in chassis, as terminal handling instruments whose main concern is ensuring that the chassis model supports optimal terminal performance at the lowest cost to the terminal. From this perspective, the transition from the historical ocean carrier–controlled model to various pooling approaches has considerably improved terminal utilization and performance in the same vein as described above. Ocean carriers surveyed as part of this research effort indicated chassis count reductions on the order of 20% to handle equivalent cargo levels after port-wide and region-wide pools were implemented.

The landlord port authorities have a strong indirect interest in chassis relating to optimal terminal land use and performance metrics such as gate-in to gate-out turn times, which are concerns of shippers and motor carriers, important constituents of the ports. The ports the researchers interviewed have estimated that terminal tenants devote between a low of 6% and a high of 15% of improved on-terminal land to chassis storage. It is recognized that if chassis are moved to an off-site, near-port location, existing terminal capacity could increase. In the current political and economic atmosphere, with fiscal constraints and environmental concerns over expanding harbor footprints, public port authorities are highly motivated to grow port business, which means jobs, without additional investment.

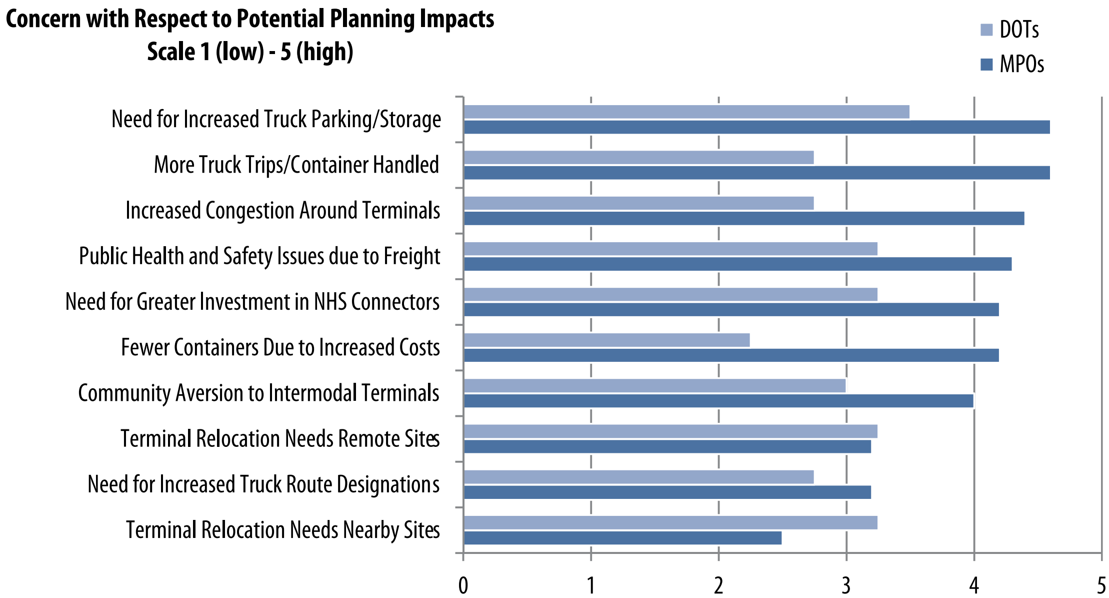
The challenge facing landlord ports with respect to the emerging chassis models is how to exert influence without stepping into an operating role. Moreover, as public entities, the ports must be cognizant of the concerns of all stakeholders, not just their tenants. Motor carriers, labor unions, shippers, and even the local populace will have a voice in any landlord port–led initiative. Port authorities the researchers spoke with are strategizing how to harness their various constituencies with their differing priorities to develop workable solutions.

6.3 Specific Public Policy and Planning Issues Emerging from Evolving Chassis Supply Models

As chassis supply models in the U.S. continue to evolve, it is difficult and too early to reach any direct conclusions on the related potential impact on key areas of interest to public policy makers and planners. As a rule, public authorities need to be wary of any chassis model evolutions that shift private, commercial costs onto the public via increased maintenance, congestion, or emissions and the like.

This section discusses potential issues emerging from the changing chassis supply landscape, as relevant to these public stakeholder groups. As a point of departure, Figure 6-1 frames the perceived areas of greatest concern for public policy and planning organizations, as identified by the team in consultation with public stakeholders.

Figure 6-1. Public Stakeholder Perceived Concerns with Respect to Evolving Chassis Supply Models



It is interesting to note that local agencies had a higher average level of concern about potential chassis issues than state DOTs. This is primarily due to the concentrated local impact of chassis supply transitions around terminal sites, which creates a more significant planning concern for local agencies. For both state and municipal agencies, the potential need for more truck parking or storage was the paramount concern. At the local level, increased truck trips and parking were the two greatest concerns. At the state level, increased parking, investment in NHS connectors, and potential terminal relocations were of highest importance.

From this list of public policy and planning organizations concerns, the following two are particularly notable:

- Potential for increased truck moves/miles/idling and related externalities (congestion, emissions, noise, and wear and tear on roads).
- Land-use planning implications.

Each concern noted is summarized below.

6.3.1 Potential for Increased Truck Moves

A number of chassis supply scenarios could lead to increased truck moves, either bobtail moves (tractor without chassis) or bare chassis moves (chassis without container). It is not the alternative chassis supply model, per se, that will directly influence increased truck moves/miles, but rather how chassis are supplied, managed, and stored (in particular, the storage location). For example, as shown in Section 2.2.2, greater truck moves and terminal gate transactions are required in a common routine of picking up an import container from a grounded terminal and returning the empty (live-unload operation) to the same terminal when chassis storage is moved off terminal (see Table 2-1).

As noted in the text preceding Table 2-1, this table is based on an illustrative example. The number of truck moves and gate transactions would differ in drop and hook operations, depending on whether the truck returns with a loaded chassis or not, and the nature of the terminal operation (e.g., wheeled vs. grounded). (See Table 6-1.)

Table 6-1. Truck Moves and Gate Transactions by Storage Type

Chassis Storage	Number of Gate Transactions	Number of Truck Moves
On-Terminal	4	2
Off-Terminal	8	4
Motor Carrier	4 (2 bare chassis)	2

Source: Based on operating assumptions outlined in Table 2-1.

In the motor carrier model, the first and last moves between the terminal and motor carrier yards would now be bare chassis instead of bobtail. Towing the bare chassis could have an impact on consumption and emissions, congestion, safety, and road wear and tear.

It is important to note that if or when changes to chassis domiciles are made, truckers are keenly aware of fuel and labor costs, which are their number one and two costs of doing business. Many truckers may reduce empty miles by linking inbound empty boxes to outbound export loads. Several load matching services today are making this information available to the trucking community with proven results in reducing empty miles.

With respect to public policy and planning organizations, the physical location at which chassis are stored could also affect land use and likely have an impact on the number of truck moves around terminals and to near-terminal motor carrier yards.

Externalities from Increased Truck Moves

Although no data exists about the changes in trucking patterns caused by a change in chassis models or a shift to domicile chassis off-terminal sites, the potential increase in truck movements could lead to a number of negative externalities, including the following:

- **Increased air emissions:** Increased truck moves caused by off-terminal chassis yard storage described above could lead to increased air emissions in two ways. First, through the additional mileage trucks are required to make to drop off/pick up chassis, and second, through additional idling time caused by doubling the number of gate inspections. If off-terminal chassis storage yards are located close to terminals, which may be the most operationally expedient, it could have a particularly significant impact on areas around marine or inland container terminals.
- **Increased congestion:** Increased truck moves could also generate additional congestion on roadways around terminals, intermodal connectors, and to and from BCO facilities. Commerce and economic development leaders are concerned about regional competitiveness and the ability to attract manufacturing jobs and commercial businesses. Prospective businesses understand the cost of congestion and the benefit of international and intermodal access.
- **Increased noise:** With increased truck traffic would come increased noise from trucking operations.
- **Increased wear and tear on roads and intermodal connectors**: Likewise, additional truck traffic would put more pressure on roads and bridges, including intermodal connectors in particular. This can result in increased road maintenance and rehabilitation cost, which is of course typically borne in large part by taxpayers. To the extent that changes in chassis models increase use of NHS connectors, public agencies must be prepared to update long-range plans and seek additional funding sources.

The costs of these externalities are typically borne by the larger public and can have a negative economic consequence for a region.

6.3.2 Off-Terminal Land-Use Planning Implications

The most important off-terminal land-use implications with respect to evolving chassis supply models concern chassis storage. Historically in the U.S., chassis have, for the most part, been stored at the terminal sites. Certain chassis supply models do, or could lead to increased off-terminal storage, which could impose new or changed pressures on land use both on and off terminal sites (Table 6-2).

Table 6-2. Potential Implications for Land-Use Footprint for Different Chassis Storage Models

Storage Location	Implication for Land-Use Footprint
On-terminal	Chassis land-use footprint greater in wheeled versus grounded terminal. Limited land-use impact outside terminal, until terminal capacity reached, necessitating more land for operations.
Off-terminal	Consolidated near-terminal depots (single) could have lowest land-use impact. Decentralized chassis storage (many small depots) would likely lead to increased overall chassis storage land-use footprint and potential for greater conflict with zoning and land-use plans as greater number of sites spread-out. Most efficient land utilization (freight throughput per acre) is inside terminals with no chassis storage, grounded operations only. All scenarios would result in an increase in vehicle miles traveled per container move.
Motor carrier facility	Potential for highest land-use impact outside terminal if motor carriers each acquire storage space. Motor carriers must move or buy nearby sites to expand. As is the case with off-terminal, most efficient land utilization (freight throughput per acre) is inside terminals with no chassis storage, grounded operations only.

Table 6-3 provides a simplified summary of generalized implications of alternative chassis supply models on land use and chassis storage footprint.

Table 6-3. Alternative Chassis Supply Models and Generalized Land-Use Implications

Chassis Supply Model	Land-Use Implications
(Conventional) Ocean Carrier Chassis Model	• Status quo—chassis stored within the terminal site. Potential for some off-terminal storage when terminal land constrained. • As container traffic volumes and terminal throughput grows, increasing container storage requirements could crowd out existing chassis storage areas. • Likewise, as wheeled terminal space becomes constrained, pressure increases to shift to grounded container operations.
Chassis Pool Models (Co-op, Neutral, Terminal)	• As above. • Near/off-site terminal storage would, in effect, increase the footprint of the terminal activity–related operations, which could have land-use planning implications.
Motor Carrier or Logistics Company Owned (or Leased) and Operated Chassis Model	• Increased chassis storage need at motor carrier sites could lead to increased footprint requirements of motor carriers involved in drayage business. • Potential for third-party storage lots of motor carrier owned chassis.

6.3.3 What Should Public Agencies and Planning Organizations Do Going Forward?

Public agencies will have different approaches to handling chassis depending on the nature of their involvement and the number of chassis in their respective regions. Since the transition to new chassis models could affect regional traffic flows and land use, public officials and planning organizations may benefit from the following:

- Developing an inventory of chassis support facilities, equipment depots, and truck parking needs and facilities within their region and keeping track of related traffic flows.
- Identifying how changes in the chassis models will affect truck traffic volume and congestion impacts on local roads and regional intermodal connectors.
- Reviewing land-use and zoning plans, particularly around intermodal terminals to address or mitigate any emerging issues resulting from changes in chassis supply practices.
- For state DOTs and MPOs, developing a dialogue with port authorities to become and stay informed with respect to any changes in how chassis are stored within the terminal complexes. Port authorities are their counterparts serving the general public but with a closer view of the chassis situation.
- Encouraging private-sector participation in public planning efforts, particularly over the mitigation of negative externalities such as congestion.
- In the context of the chassis supply models identified in this Guidebook, staying informed of prevalent models in their region and of which organizations (leasing companies, ocean carriers, motor carriers, rail and marine terminal operators) are influencing change.

In short, public agencies and planning agencies should stay informed of any chassis-related developments in their respective regions, as changes in chassis supply markets are bound to continue to evolve in the short/medium term.

Conclusions

The U.S. chassis market is unique compared to the rest of the world and is the product of historic and structural differences in the organization and operation of U.S. container supply chains. Lower gross vehicle road weight restrictions than in other countries (which lead to differences in chassis specifications), historic ocean carrier chassis ownership and supply, the use of chassis in operations at wheeled terminals, the practice of chassis drop and hook and free time for loading/unloading operations at BCO facilities, variances in regional drayage distances, increased regulatory scrutiny, and the relative lack of developed off-terminal chassis storage are some of the differences that have shaped the U.S. chassis supply landscape and its evolution.

Within this unique U.S. context, alternative chassis supply models (to the traditional U.S. model of chassis supply by individual ocean carriers) have emerged over the past decade to improve chassis utilization, to minimize related operating costs, to respond to terminal capacity constraints, and to improve efficiency of operations, among other reasons. This transition to new models has happened in different ways, to different degrees, and heterogeneously across the country, and has been driven by different regional issues, constraints and players, resulting in a patchwork of different models and regional disparities. Heterogeneity is expected to continue to be a characteristic of the U.S. chassis supply environment as no single chassis supply model is emerging as universally preferable by all stakeholders or across all regions, certainly in the short to medium term.

The trend in the evolution of U.S. chassis supply over the past decade has been toward various forms of chassis pools, which are also unique to the U.S. Chassis pool models include regional ocean carrier cooperative (co-op) chassis pools, neutral (third-party owned—usually leasing companies) chassis pools, and terminal-controlled chassis pools. Today, approximately 75% of marine chassis are supplied through these chassis pool models. Individual ocean carrier container chassis supply models still exist, although most are taking active steps, in varying degrees of effect, to discontinue providing chassis. One notable recent example is the divestiture of the Maersk Line chassis business, one of the largest ocean carrier chassis fleets, to a private equity company. Motor carriers in the U.S. own and control a very small proportion of standard ocean container chassis, unlike elsewhere in the world where the motor carrier and logistics company chassis supply model is predominant.

At present, the U.S. ocean container chassis supply market is in a state of flux. As more ocean carriers seek to exit the chassis supply business and the U.S. chassis environment continues to evolve, the emerging questions are: *What will be the future form(s) of chassis supply in the U.S., and what are the implications for chassis supply stakeholders?* Who will own, manage, and supply chassis, how will chassis charges work, and where will chassis be domiciled are some of the unanswered questions of particular relevance to U.S. ocean container supply chains and stakeholders.

The answers to these questions remain unclear, but the future of chassis supply in the U.S. is likely to be guided in large part by the same factors that shaped its recent evolution, as follows:

- **The structural chassis supply context:** Established BCO logistics practices, including the drop and hook chassis operations, chassis pool arrangements, and wheeled terminal operations are some of the factors that preclude a rapid and wholesale change to chassis supply and management practices.
- **The heterogeneous nature of the chassis supply landscape:** Chassis supply options are best viewed not monolithically, but regionally, as chassis pools in general are organized and operated by city, port complex, or linked by multiple terminals and ports within a geographic region based on container flow. Terminal operators, motor carriers, and other stakeholder groups such as unions also have a geographic construct, and as such, chassis model

transitions will likely be forged region by region, in a manner that accommodates the commercial and operating practices of the stakeholders in that region.

- **Multiple and often unaligned interests of chassis supply stakeholders:** Ocean carriers, motor carriers, BCOs, terminal operators, chassis leasing companies, unions, and public policy organizations, among others are all key stakeholders in chassis supply. Their respective perspectives, interests, and performance goals related to chassis supply differ as do their perceived advantages and disadvantages of alternative chassis supply models. There is no single chassis supply model that is universally preferred by all stakeholders.

Because each stakeholder group is significantly invested in the current chassis supply models—either financially or operationally—no one faction will likely control or singlehandedly influence the direction of the chassis supply transition in the U.S. Rather, the future evolution of chassis supply in the U.S. will be the result of the interplay of various stakeholder interests, influences, and regional differences within the structural chassis supply context that shaped the U.S. chassis supply landscape.

Nevertheless, on the basis of consultations with stakeholders across the ocean container supply chains, chassis models in the U.S. will likely continue to evolve toward pooling in the short to medium term as there is general stakeholder consensus that there are efficiency benefits to the supply of chassis from pools in one form or another. The perceived benefits of pooling include increased chassis management efficiencies, utilization and adequacy/balance of supply, decreased risks of chassis-caused service failures and related delays to BCO cargo transportation plans, and a reduced on-terminal chassis storage footprint relative to the traditional individual ocean container chassis supply model.

In the longer term, there are simply too many factors at play to definitively predict the ultimate outcome of the evolving chassis supply environment in the U.S. Most ocean carriers will likely continue to want to divest their role in chassis supply and eventually exit the chassis business altogether. BCOs will continue to want adequate chassis supply and terms that are in line with their logistics operations. Terminals may prefer to minimize on-terminal chassis storage to what is necessary for efficiency in order to maximize their terminal capacity for container storage and operations. On the basis of consultations, it appears that motor carriers may continue to resist a move to the motor carrier chassis supply model, as is standard elsewhere in the world. These are trends identified in the course of the research effort for this Guidebook, but the end result, and the role of each stakeholder in that end result, remains speculative.

Whatever the outcome and the pace of the transition, public policy and planning organizations will need to be aware of the evolving chassis supply models in the U.S. given potential implications for the public. In particular, increased truck moves/miles and land-use initiatives could result by moving chassis storage away from marine and rail terminals, where the majority of the ocean container chassis are staged today. This in turn could lead to a host of externalities including increased air emissions, noise, congestion, wear and tear on roads and intermodal connectors, among others. Chassis supply transitions could also have implications for broader regional competitiveness and economic development related to transportation sectors and containerized trade.

In any case, time will tell what the longer-term implications of the evolving U.S. chassis supply environment will be. In the meantime, it would be in the interest of all chassis supply stakeholders to understand the broad implications of the evolving chassis supply environment—both from the perspectives of their own stakeholder group as well as that of others—and the implications for broader U.S. ocean container supply chains. This Guidebook is intended to go some way in doing this, although it is recognized that more research will be required, at the regional level, as chassis models evolve to promote a fuller understanding of the resulting implications for U.S. ocean container supply chains and public interest.

Validation of Guidebook Findings and Conclusions

In addition to the review function provided by the NCFRP Project 43 panel, the findings and conclusions in this Guidebook were validated with a wide range of relevant stakeholder groups, including ocean carriers, BCOs, terminal operators, motor carriers, chassis leasing companies, chassis pool operators, labor unions, public planners, and policy makers.

Close to 200 individuals participated in the validation process. The validation process included both informal feedback on the Guidebook, as well as formal responses to two questionnaires—the first following a Webinar on the NCFRP Project 43 findings, and a second after the release of the draft Guidebook itself.

On the whole, the vast majority of stakeholders that participated in the validation process supported the study results and findings. Specific validation results from the more comprehensive Guidebook questionnaire are as follows:

- Close to 90% of respondents rate the Guidebook as "very useful" (51%) or "useful" (37%) in describing ocean container supply models in the U.S. and related issues and implications.
- Over 90% of respondents rated the factual accuracy of the Guidebook as "Excellent" (31%) or "Good" (60%).
- 84% of respondents found the Guidebook fair and representative of all chassis supply models (with the balance indicating "not sure").
- Of the various stakeholder perspectives presented in Chapter 5, close to 90% of those that expressed an opinion agreed that the expressed advantages and disadvantages of the alternative chassis supply models were reasonably accurate (32% noted neither agreement or disagreement).

There was also broad agreement with the study's main conclusions, as summarized in the survey results below.

Survey Results

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Established BCO logistics practices, including the drop and hook operations, as well as chassis pool arrangements, and wheeled terminal operations will preclude a rapid and wholesale change to chassis supply and management.	3.2%	9.7%	22.6%	41.9%	22.6%
The heterogeneous nature of the chassis supply landscape will result in the evolution of chassis supply practices on a regional rather than a national basis.			25.8%	41.9%	32.3%
No one faction will control or single-handedly influence the direction of the chassis supply transition in the U.S.—future evolution will be the result of the interplay of various stakeholder interests, influences, and regions.		9.7%	19.4%	25.8%	45.2%
In the short to medium term, chassis supply models in the U.S. will likely continue to evolve toward pooling, in one form or another.		6.5%	6.5%	54.8%	32.3%
Public policy and planning organizations should conduct outreach efforts to identify evolving chassis supply issues with private-sector stakeholders throughout the transition.		9.7%	19.4%	38.7%	32.3%
Additional research, at a regional level, would be useful to inform regional stakeholders of regional chassis supply issues and related dynamics.		3.2%	25.8%	35.5%	35.5%

Source: Results of post-NCFRP Project 43 Guidebook validation questionnaire (Questions 22–27), as compiled by the researchers.

In short, though there are certainly differences of opinion about the future evolution of chassis supply models in the U.S., there is broad support that the NCFRP Project 43 Guidebook (*NCFRP Report 20*) provides a useful reference document on the evolution of ocean container chassis supply in the U.S. and the implications for chassis supply stakeholders. Over 70 percent of stakeholders nevertheless "strongly agree" or "agree" that more research would be useful at the regional level to better understand chassis supply issues and dynamics and better inform decisions with respect to chassis supply at the regional level.

Glossary of Terms

Term	**Definition and Use**
Bad-order chassis	Defective chassis.
Beneficial cargo owner (BCO)	Importer/consignee/buyer, exporter/shipper/supplier/vendor physically possessing the cargo and not a third party in the movement of such goods.
Bill of lading	A contractual document between the shipper and carrier detailing the type, quantity, and destination of goods being carried. The bill of lading always accompanies the shipped goods, no matter the form of transportation.
Bobtail	A truck tractor with no trailer attached.
Carrier haulage	Movement of a container between two points under control of the shipping line using a haulage contractor nominated by the shipping line. Carrier (shipping line) accepts claims, liabilities, or damages that arise during the move.
Chassis and container repositioning	The repositioning of empty containers and chassis, usually as a return move to source/port/owner or for another cargo move/pickup.
Chassis flip	The transfer of a container from the chassis it is resting on to another chassis.
Chassis pools	Clusters of collectively managed, common-use chassis contributed by ocean carriers, third-party leasing companies, marine terminal operators, or rail companies, used by motor carriers in the movement of containers.
Domestic container	Container moving exclusively between points in North America, with no seaborne travel. Predominantly 53 feet in length.
Domestic container chassis	Chassis that can accommodate longer (53-foot) domestic containers, and typically can be adjusted in length.
Drayage	The transport of intermodal containers over short distances by trucks, as part of a much longer overall move.
Drayage motor carrier	A trucking company that provides short-distance haulage between ports, BCO facilities, and rail ramps or marine terminals.
Drop and hook operation	When a container and chassis are unhooked from the truck tractor, left at a BCO facility for loading or unloading, and picked up by truck again at a later time or day. Opposite of live-unload operations.
Live-load/unload operations	When the same truck and driver stays with the chassis and container until loaded or unloaded and returned to the terminal. Opposite of drop and hook operations.
Gross vehicle weight (GVW)	Total weight of a vehicle when loaded, including the weight of the vehicle, container, trailer, chassis, and cargo (as applicable).
Grounded marine terminal	A marine terminal in which containers are stacked on the ground rather than pre-loaded on a chassis waiting for disposition.
Wheeled terminal	Terminals where the majority of containers are stored on chassis, rather than stored on the ground. However, all terminals reserve a share for wheeled operations to handle reefer and hazmat cargo.
Intermodal	A shipment that moves over more than one transport mode (i.e., marine and truck, marine and rail, rail and truck, etc.).

Intermodal equipment provider (IEP)	Any entity that interchanges intermodal equipment with a motor carrier pursuant to a written interchange agreement or has a contractual responsibility for the maintenance of the intermodal equipment.
ISO container	Intermodal container meeting one of five common International Organization for Standardization (ISO) standards. International marine ISO containers are 20, 40, and 45 feet in length. Domestic ISO containers in U.S. are 48 or 53 feet in length.
Independent owner-operator trucking company	An independent motor carrier that owns a truck and offers its service to BCOs and larger motor carriers.
Merchant haulage	Movement of a container between two points directed by the consignee using a nominated haulage contractor. Shipping line accepts no claims or liabilities or damages.
Motor carrier	Land transport trucking company.
Neutral chassis pools	Chassis pools whereby chassis are provided and managed by a third party and users are charged a per diem rental rate to use them. Rate covers the cost of maintenance and repair, but not repositioning.
Non-vessel operating common carrier (NVOCC)	A company that brokers full container and less-than-container ocean transportation without owning vessels by buying space from ocean carriers and selling space to BCOs.
Ocean carrier	Shipping line carrying cargo across oceans.
Ocean carrier free time	Number of days a BCO can keep the container and chassis at its facility before charges start accruing from the ocean carrier.
Ocean container chassis	Wheeled frame designed to carry marine containers for the purpose of truck transport between terminals and BCO facilities.
Owner-operator drayage model	Model whereby drayage firm dispatches, manages, or administers truck drayage activities to and from terminals, primarily by sub-contracting work to individual owner-operator trucking companies.
Slider chassis	Chassis that can be extended or shortened in length to accommodate different sizes of containers or requirements to better distribute weight to meet maximum weight restrictions on roads and bridges.
Tare weight	Weight of an empty vehicle (truck tare weight) or container (container tare weight).
Third-party chassis leasing companies	Chassis leasing companies that are not ocean carriers or motor carriers.
Third-party logistics (3PL)	A third party that contracts for customs brokerage, logistics, warehousing, freight forwarding, haulage, consolidation and deconsolidation or other value-added services on behalf of a BCO.
Transshipment	Shipment of container/cargo to intermediate destination(s) between origin and final destination. Often involves a change in mode of transport (vessel to truck, truck to rail, etc.), called transloading.
Tri-axle chassis	Chassis with additional (third) axle, used primarily to distribute weight and maximize container weight capacity for heavier cargo loads.
Triple-net lease	Chassis leased to customers who prefer to operate and maintain their own equipment. Customer pays the lease amount, insurance, taxes and maintenance over a fixed length of time, usually between 1 and 7 years.
Unitary pool concept (UPC)	A CCM term referring to a non-ocean carrier chassis contributor to a CCM co-op pool, which has a contractual arrangement with pool users.
Vessel-sharing agreement (VSA)	Agreement between two or more ocean carriers in which a number of container positions are reserved on particular vessels for each of the participants. Used to create operational efficiencies across carriers.

Acronyms and Abbreviations

3PL	Third-party Logistics
BACP	Bay Area Chassis Pool
BCO	Beneficial Cargo Owner
CCM	Consolidated Chassis Management
CIMC	China Intermodal Marine Containers (Group) Ltd.
CYKH	Cosco, Yang Ming, K-Line, Hanjin
COCP	Chicago Ohio Valley Consolidated Chassis Pool
COFC	Container on flat car
CO-OP	Cooperative
CPCS	CPCS Transcom Ltd.
CY	Container yard
DCCP	Denver Consolidated Chassis Pool
DCLI	Direct ChassisLink Inc.
DOT	Department of Transportation
GCCP	Gulf Consolidated Chassis Pool
GVW	Gross vehicle weight
HMM	Hyundai Merchant Marine Co., Ltd.
HRCP	Hampton Roads Chassis Pool
IAM	International Association of Machinists
IANA	Intermodal Association of North America
IEP	Intermodal Equipment Provider
ILA	International Longshoremen's Association
ILWU	International Longshore and Warehouse Union
ISO	International Standards Organization
LABP	Los Angeles basin pool
MC	Motor Carrier
MCCP	Mid-South Consolidated Chassis Pool
MPO	Municipal Planning Organization
MWCP	Midwest Consolidated Chassis Pool
NERP	Northeast Regional Pool
NHS	National Highway System
NVOCC	Non-Vessel Operating Common Carrier
OCEMA	Ocean Carrier Equipment Management Association
RILA	Retail Industry Leader Association
SACP	South-Atlantic Consolidated Chassis Pool

TEU	Twenty-foot Equivalent Unit
TIP	Transportation Improvement Plan
TNWA	The New World Alliance
TOFC	Trailer on Flat Car
UPC	Unitary Pool Concept
VSA	Vessel-sharing Agreement

Appendix A: Alternative Chassis Supply Model Case Studies

A.1 Co-op Chassis Pool: Chicago Ohio Valley Consolidated Chassis Pool, LLC (COCP)

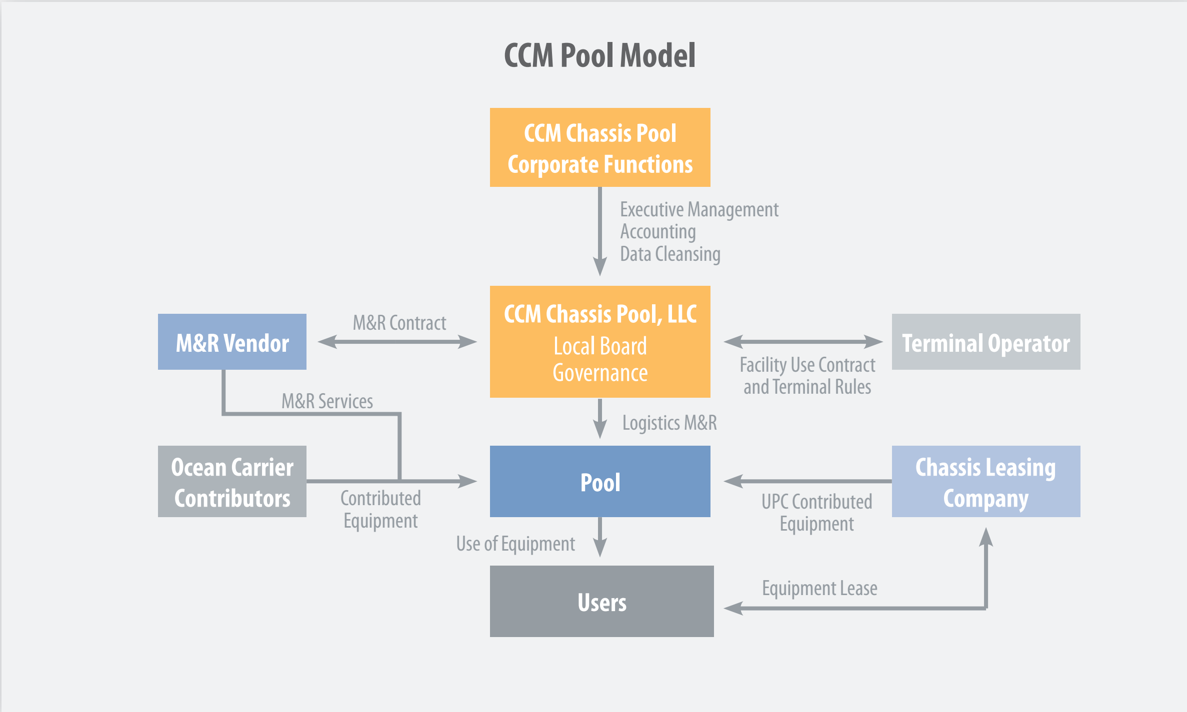
CCM cooperative chassis pool serving Greater Chicago and Ohio Valley area

Background: Consolidated Chassis Management LLC

Consolidated Chassis Management LLC (CCM) operates nearly one in four marine chassis within its pools, making it the largest co-op chassis pool operator in the U.S. CCM operates six cooperative (co-op) chassis pools throughout the U.S., covering a significant amount of the intermodal geography. Each pool serves a majority of the OCEMA carriers, though in each area some shipping lines have chosen a different model. Each pool also has non-OCEMA members, either as chassis contributors in a UPC capacity, or as chassis users. The chart below provides a summary statistical profile of the CCM pools.

Pool Name	Chassis Count	List of Cities	Total Locations Served	Number of Members	Number of Non-Ocean Carrier Members
COCP	29,517	Chicago, Cincinnati, Cleveland, Columbus, Detroit, Georgetown, Grand Rapids, Indianapolis, Louisville, Marysville, Milwaukee, Peoria	88	13	2
DCCP	3,668	Denver, Salt Lake City	12	14	4
GCCP	28,590	Dallas, El Paso, Houston, Laredo, Mobile, New Orleans , San Antonio	63	13	2
MCCP	15,136	Huntsville, Memphis, Nashville	33	16	1
MWCP	9,653	Kansas City, Omaha, St. Louis	23	14	2
SACP	42,245	Atlanta, Birmingham, Charleston, Charlotte, Jacksonville, Savannah, Tampa, Wilmington	58	21	2

CCM does not operate pools in the Northeast, West Coast, and Norfolk, as alternative chassis pools had already been established in those areas. Each individual CCM pool above is a limited liability company and is considered the intermodal equipment provider (IEP) of the chassis it operates. The basic governance, contractual and operational structure of the CCM co-op model is exhibited below.



CCM is overseen by an executive committee of OCEMA members, and has appointed a president to manage the business. While each pool has its own governance committee for rule implementation and enforcement, there are also on-site staff to execute supply, logistics, and maintenance and repair oversight. CCM has contractual hosting agreements with terminals in its pools that determine operating and storage rules, and contracts with third-party companies to perform maintenance and repair. Currently CCM operates five out of its six pools, and is planning to incorporate the last one into its own management structure this summer. Over 100 people are employed to manage the five CCM-managed pools. CCM has developed its own operating systems, through which it tracks chassis, updates movements, manages maintenance and performs accounting functions.

CCM's development and growth has likely altered the U.S. chassis model landscape for good, as ocean carriers, terminal operators and motor carriers have reported productivity and efficiency improvements through the chassis pool structure versus the individual ocean carrier management model. As co-op pools have matured and stakeholders become accustomed to it, CCM is facing the challenge of responding to the next chassis model evolution, transitioning chassis responsibility to other stakeholders, most notably motor carriers. The COCP LLC Pool, one of the largest in CCM, is described below.

COCP Pool

Brief Description: The COCP, established in 2009, is a CCM cooperative chassis pool, 96% contribution by 11 OCEMA carriers and the remaining contribution from a non-OCEMA carrier and a leasing company. COCP operates in Chicago, Columbus, Cleveland, Detroit, Louisville, Cincinnati, Indianapolis and Milwaukee, and is CCM's largest inland chassis pool, comprised of nearly 80 rail ramps and depots.

Chassis Ownership Structure: The ocean carriers contribute owned and leased chassis, the percentages of which are not readily available. One leasing company, acting as a UPC, contributes its own chassis, which is approximately 3% of pool assets.

Chassis Control Structure: The COCP controls the chassis and is responsible for supply, logistics and maintenance, and the pool is considered the intermodal equipment provider (IEP).

Total Chassis Count: The COCP contains 8,086 x 20′, 20,777 x 40′, and 722 x 45′ chassis, which represents an estimated slightly less than half of marine chassis in the served region.

Chassis Pool Manager: Currently TRAC Intermodal, whose contract expires June 2012, after which CCM will assume direct management.

Number of Contributors: 12 ocean carriers and one leasing company as UPC.

Number of Users: 19 total companies are pool users, seven of which are represented by TRAC Intermodal in their capacity as UPC. The vast majority of users are ocean carriers, but there are other transportation entities, such as a railroad, motor carrier and a logistics company that are non-contributing users of the CCM pool through the UPC structure.

Terminal Operating Description: The COCP operates at nearly 80 locations of about equal number of rail ramps and container yards (CYs); over 90% of the traffic moves through wheeled terminals, with the rest being rail "live lift"/grounded. Chassis are stored at all-wheeled ramps (and CYs), but no storage is allowed on any of the live-lift facilities. There are a high number of container yards included in the COCP to accommodate the various ocean carriers' container storage requirements in the eight city locations covered by the pool.

Generally in CCM pools, once a chassis arrives at its commercial destination, the usage clock is stopped (labeled "start/stop" in the chart below). However, in COCP, because there are many CYs that only serve a single COCP customer, chassis usage continues even inside those single-customer CYs. At these CYs, usage may be transferred to another pool user if it uses the chassis, and so those locations are known as "swap" destinations.

All chassis are subject to gate inspections. In the COCP, nearly all the rail ramps inspect chassis at the in-gate using automated gate systems (AGS), in which a gate clerk inspects the chassis from a photographic image inside the terminal housing structure. All of the CYs perform physical in-gate inspections of the chassis.

Maintenance and repair are performed by third-party maintenance companies at the rail facilities, and most of the CYs perform their own M&R. There is a union repair company servicing a single location in the COCP.

Local/Intermodal Mix: As an inland chassis pool, all cargo by definition is intermodal.

Cost Structure: COCP includes the following cost categories in their expense allocation to members:

- M&R
- Repositioning
- Administration
- General Operations – includes lifts/handling

A.2 Neutral Pool Chassis Supply Model: Bay Area Chassis Pool (BACP)

Neutral pool in Oakland, CA

Brief Description: Established in 2010, the BACP is open to ocean carriers, motor carriers and other chassis users. The pool covers three marine terminals (Total Terminal Inc., the Oakland International Container Terminal, and Ports America Outer Harbor), the Union Pacific RR and two off-terminal container yards.

Chassis Ownership Structure: Flexi-Van owns and contributes 100% of the chassis in the BACP.

Chassis Control Structure: Flexi-Van controls 100% of the chassis, and is responsible for supply, maintenance and management; it is the designated intermodal equipment provider (IEP).

Total Chassis Count: 4,800 marine two-axle chassis: 1,600 x 20', 3,300 x 40', 150 x 45'.

Chassis Pool Manager: Flexi-Van.

Number of Contributors: One (all Flexi-Van assets).

Number of Users (defined as a paying entity): The BACP has 10 ocean carriers and 244 motor carriers as direct customers.

Terminal Operating Description:

	Wheeled/Grounded	Chassis Gate Inspection	M&R/Union	Chassis Storage
TTI	Mixed;	No inspections	PCMC/ ILWU	On terminal; fixed number
OICT	Grounded	No inspections	SSA/ IAM	On terminal, dedicated acreage; fixed number
PA Outer Harbor	Wheeled – 60-70% about 210 acres	No inspections	PCMC/ILWU	On terminal, fixed number
UP	Wheeled	No chassis inspection	IMS/non-union	On terminal, fixed number
BN live lift	Wheeled for BN pool, managed by FV (BN is only start-stop; about 500 units); but not the BACP	In-gate on chassis	Eagle/union	N/A
2 Container Yards	Grounded	Full in-gate inspections	CGI United intermodal	On-terminal storage allocation

Local/Intermodal Mix: Local: 65%   Intermodal: 35%

Carrier vs. Merchant Haulage: Estimated to be no different than other regions.

Insurance Coverage: Liability covered under Flexi-Van corporate insurance policy.

Cost Structure: The BACP includes the following costs in its rate:

- Cost of Chassis Asset
- M&R
- Repositioning – included for MCs, but not for OCs, which pay a separate repositioning charge
- Administration
- System
- Insurance

Relationship with Ocean Carriers Exiting Chassis: Half the ocean carriers in the BACP have started the transition to Flexi-Van directly invoicing motor carriers for select chassis moves. Some ocean carriers are requiring the motor carriers to pay for all chassis moves; other ocean carriers are absorbing the chassis cost on carrier haulage. There continue to be a significant number of shipper exceptions to the stated ocean carrier chassis policies.

A.3 Terminal Chassis Pool: SSA Pacific Northwest Pool

Terminal Chassis Pool, Seattle, WA

Brief Description: SSA, one of the largest U.S. marine terminal companies, operates a terminal-controlled chassis pool at its two Seattle marine terminals (known as T-18 and T-30). SSA provides the assets, manages the chassis and performs the maintenance. Ocean carriers have the opportunity to contribute their assets to the SSA pool. SSA also provides billing services for ocean carriers that are sub-leasing chassis to motor carriers through the SSA pool.

Chassis Ownership Structure: Ocean carriers: 10% Leasing companies: 65% SSA: 25%

SSA leases the majority of the chassis in their pool, but has recently purchased chassis from an ocean carrier that is in the process of exiting chassis ownership. For the purposes of this case study, the chassis for the two ocean carriers that contribute assets to the SSA pool are considered ocean carrier owned.

Chassis Control Structure: SSA: 100%

SSA is fully responsible for supply, management and maintenance and is the designated intermodal equipment provider (IEP).

Total Chassis Count: 2,100

Chassis Pool Manager: SSA

Number of Contributors: Four – two ocean carriers, one leasing company and SSA

Number of Users: Seven ocean carriers and 125 motor carriers are direct paying customers of the SSA pool.

Terminal Operating Description:

	Wheeled/Grounded	Chassis Gate Inspection	M&R	Chassis Storage
SSA T-18	Grounded; wheeled if adequate space	Out-gate only	SSA/IAM	3 acres on terminal
SSA T-30	Grounded	Out-gate only	SSA/ IAM	3 acres on terminal
UP	Live-lift	N/A	N/A	N/A
BN	Live-lift	N/A	N/A	N/A

Local/Intermodal Mix: Within the SSA terminals, approximately 55% of cargo is moved via rail, and 45% is considered "local". On-terminal rail is used extensively at Terminal 18, without using pool chassis, whereas Terminal 30 rail cargo transits to the UP and BN facilities all by pool chassis.

Drop and Hook vs. Live Unload: Similar to other West Coast regions – majority is drop and hook.

Carrier vs. Merchant Haulage: Estimated to be no different than other regions.

Insurance Coverage: By law, motor carriers must have at least $1 million. As IEP, SSA has $30 million in coverage and requires same from the ocean carriers that still get invoiced for chassis usage.

Cost Structure: SSA includes the following costs in its rate:

- Chassis asset
- M&R
- Repositioning
- Administration
- System

SSA charges for each chassis transaction, so a single chassis making multiple out-gates in one day will be charged for each out-gate.

Relationship with Ocean Carriers Exiting Chassis: Three ocean carriers have implemented programs within the SSA neutral pool to have SSA invoice truckers based on business rules established by the individual ocean carrier. SSA is managing the contract, invoicing and collecting process for two lines, while the third line is using an independent company.

A.4 Co-op Terminal Chassis Pool: Hampton Roads Chassis Pool (HRCP) II

Terminal-operated cooperative pool in Norfolk, VA

Brief Description: HRCP II LLC was established in 2003 as the nation's first port-wide cooperative chassis pool, connecting all the marine terminals and rail facilities in the Norfolk area. Under this cooperative arrangement, the ocean carriers contribute chassis to support their cargo requirements, and a third party manages the macro supply and maintenance. HRCP II is owned by Virginia International Terminals (VIT), the terminal operator of the Hampton Roads ports of Norfolk International Terminal (NIT), APM Terminals Portsmouth (APMT), and Newport News Marine Terminal (NNMT). The pool covers all VIT-operated terminals, as well as both Norfolk Southern and CSX Railroads, and is the only chassis pool operated in the geographic area. HRCP II has an oversight board to establish business rules, comprised of the ocean carriers and one member of VIT. For federal roadability purposes, the pool is considered the intermodal equipment provider.

Chassis Ownership Structure (estimated, data gathered from surveys): Ocean carriers: 60% Leasing companies: 40%

Chassis Control Structure: HRCP II: 100%

The pool is responsible to ensure adequate supply and maintenance of chassis to service the ports and rails.

Total Chassis Count: 11,400

Chassis Pool Manager: Virginia Intermodal Management, a subsidiary of VIT. (14 employees)

Number of Contributors: 22 ocean carriers

Number of Users (defined as a paying entity): 24 ocean carriers

Terminal Operating Description:

	Wheeled/Grounded	Chassis Gate Inspection	M&R	Chassis Storage
Norfolk International Terminal	Grounded	Manual	3 vendors, all union	Pool runs at 90% – storage can accommodate 1,000 assets
APMT	Grounded	Automated	1 vendor, all union	400 assets
PCY	Grounded	Manual	1 vendor, all union	Storage up to 2,000 assets
Norfolk Southern RR	Wheeled	Manual	Non-union	100 assets
CSX RR	Wheeled	Manual	Non-union	75 assets

Local/Intermodal Mix: Intermodal: 30% Local Truck: 70%

Carrier vs. Merchant Haulage: Estimated to be no different than other regions.

Insurance Coverage: Pool possesses $30 million insurance; contributors must have $30 million insurance, M&R vendors also have $30 million and VIM has an additional $10 million.

Cost Structure: HRCP II includes the following costs in its rate (per use-day):

- Repositioning – variable
- M&R – $4.29
- Administration – $0.44
- Liability and Insurance – $0.01

Relationship with Ocean Carriers Exiting Chassis: HRCP II's intent is to offer the lines the choice of doing business as it is conducted today as well as offering an option for the lines that wish to divest themselves from the asset. For lines opting out, VPA/VIT/APMT will be the provider of chassis as well. All operational efficiencies gained will remain intact. The only difference is to whom the invoice will go for those members that are getting out of the chassis business. In essence the fleet will remain gray.

A.5 Motor Carrier Chassis Supply Model: South Florida Region

Brief Description: The South Florida region comprising the ports of Miami, Port Everglades and the FEC Rail terminals is the largest concentration of motor carrier-operated chassis in the U.S. However, there are several chassis models within the South Florida region: In addition to motor carriers controlling the majority of the chassis, some ocean carriers own and operate chassis, DCLI provides chassis to motor carriers on a daily rental basis, and the FEC operates a small terminal chassis pool. Within the FEC Miami facility, ocean carriers and even motor carriers may supply chassis for their own use.

Chassis Ownership Structure (estimated, data gathered from surveys): Ocean carriers: 15% Leasing companies: 60% Motor carriers: 25%

With the DCLI fleet now categorized under "leasing company" control, those entities have the largest ownership share in the South Florida chassis market, though their daily model does not. Local leasing companies (as opposed to the national brands of TRAC and Flexi-Van) have a large presence in the South Florida market, unique in the U.S. They serve the multitude of small drayage operators with flexible chassis leasing options that sometimes include maintenance. There are approximately a half dozen large motor carriers, each owning more than 200 chassis. These motor carriers also own facilities for cargo and equipment storage, and supply their own maintenance on chassis.

Chassis Control Structure: Motor Carriers: 53% Ocean carriers: 20% Leasing Companies (DCLI): 25% Railroad: 2%

The entity controlling the chassis is responsible for the asset supply and maintenance, also known as the intermodal equipment provider (IEP). The control demographic changes fairly significantly from ownership, as ocean carriers and motor carriers do operate chassis as lessees. DCLI is an IEP, and with its new classification as a leasing company is now designated as such under chassis control, though the fee per day of use model does not presuppose long-term relationships. The only chassis pool in South Florida is domiciled at the FEC Railway Miami, which are leased assets managed and controlled by the FEC.

Total Chassis Count: 7,000 (approximate)

Chassis Pool Manager: N/A, except for FEC's 125-unit chassis pool, managed by FEC.

Number of Contributors: Less than 10 ocean carriers; an indeterminate number of leasing companies and motor carriers.

Number of Users: N/A, except for FEC pool, which has about a half-dozen ocean carriers.

Terminal Operating Description: Miami has three marine terminals: POMTOC, South Florida Container Terminal, and Seaboard Marine. All three are grounded facilities; in 2010 the combined port TEU liftings were approximately 850,000 TEU.

Port Everglades has five major container terminals: Port Everglades Terminals, Florida International Terminals, and terminals affiliated with liner businesses Crowley, Dole and Chiquita. The liner-operated terminals are wheeled; Crowley's operation is a mix of ro-ro and lift on-lift off, while Dole and Chiquita operate wheeled terminals for their refrigerated container cargo. Port Everglades and FIT are grounded. In 2010 Port Everglades handled approximately 800,000 TEU.

The Florida East Coast Railway operates two wheeled rail terminals, one in Miami and one in Fort Lauderdale.

Chassis Storage: Grounded marine terminals store very few chassis on terminal, while wheeled facilities at the ports and railroad do. Motor carriers that operate chassis possess depots to store chassis; for smaller truckers the local chassis leasing companies provide chassis storage.

Drop and Hook vs. Live Unload: It is estimated through surveys that 70% of cargo is live loaded/unloaded. The remaining drop and hook is predominately delivered to facilities located in very close proximity to the ports (within 20 miles).

Carrier vs. Merchant Haulage: Estimated to be no different than other regions.

Insurance Coverage: Ocean carriers do not publish their third-party liability coverage. By FMCSA, motor carriers must have at least $750,000 for non-hazardous cargo.

Maintenance and Repair: Both unionized and non-unionized labor is used; marine terminals use union labor, as do some motor carriers that operate container/chassis yards. Other motor carriers and chassis leasing companies use non-union labor to maintain chassis.

Cost Structure:

- Ocean carrier wheels: Provided free of charge.
- DCLI: $13-15/day includes asset, M&R, and insurance; a single chassis may be used multiple times and be charged one day's rental.
- Leasing company: market triple-net rate, depending on age, quality, and term of lease.
- Motor carrier wheels: Various, depending on asset and M&R expenses.

Relationship with Ocean Carriers Exiting Chassis: Most of the ocean carriers that service South Florida do not operate chassis. Maersk line had been supplying via DCLI, now divested, and now ro-ro operators, and specialty cargo (refrigerated) ocean carriers are the only ones providing chassis of significant quantities. Motor carriers have a tradition of providing chassis, and from an economic perspective, the chassis cost is bundled into the dray rate.

The operational conditions in South Florida are well-suited for motor carrier chassis control. The marine terminals, which handle the vast majority of marine containers, are grounded, and the majority of the deliveries are live unload; the combination of these factors enables the chassis to stay connected to the truck and allow motor carriers full control over the asset.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation