STRATEGIES TO MAXIMIZE ASSET UTILIZATION IN THE CALIFORNIA FREIGHT SYSTEM: PART I – BACKGROUND AND GENERAL RECOMMENDATIONS

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A White Paper from the Freight Efficiency Strategies Development Group

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National Center for Sustainable Transportation

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About the Freight Efficiency Strategies Development Group

In July 2015, Governor Jerry Brown issued Executive Order B-32-15, directing several state agencies to work together in developing an integrated action plan that will "establish clear targets to improve freight efficiency, transition to zero-emission technologies, and increase competitiveness of California's freight system" and that the plan should "identify state policies, programs, and investments to achieve these targets". In response, an interagency group was formed to oversee the development of the California Sustainable Freight Action Plan (CSFAP). Members of the interagency group include the California Air Resources Board, the California Department of Transportation (Caltrans), the California Energy Commission (CEC), and the Governor's Office of Business and Economic Development (GO-Biz). As part of developing the plan, the interagency group has solicited feedback from a broad range of stakeholders through a variety of engagement activities and outreach efforts. A component of this engagement was the development of the Freight Efficiency Strategies Development Group (FESDG) made up of freight experts from academia, industry, and government. The purpose and main task of this group was to produce a series of white papers that identify promising strategies for increasing the efficiency of the freight system. A series of six papers were developed over the course of six months. Each paper focuses on a specific theme for increasing freight efficiency within the larger freight system.

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Disclaimer

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EXECUTIVE SUMMARY

The freight system is one of the key contributors to a healthy economy. However, the vehicles, equipment, and facilities used by the different economic agents that conduct freight operations produce significant externalities: congestion, environmental emissions, and safety issues, among other impacts. Therefore, public and private initiatives, measures, or strategies to mitigate these negative externalities, and move the system onto a more sustainable path, are a priority.

In response to this need, the Freight Efficiency Strategy Development Group (FESDG), a collaborative effort between academia, public and private stakeholders, and government, was convened in August 2015 with the ultimate goal of identifying freight system inefficiencies in California and developing a set of efficiency improvement strategies.

This paper (Part I of a two-part series) discusses key findings from the effort. It provides an overview of the freight system in terms of the main stakeholders, their roles and interactions; the impacts from the type of vehicles used to move cargo in, out and throughout the State; and various pressing inefficiencies.

When investigating the dynamic among the stakeholders, several key points are identified:

- The industry objectives, business models, and regulatory compliance requirements associated with each of the large number of stakeholders are some of the factors that evidence the system's complexity.
- Although there is multiplicity of stakeholders, the performance of the system may be driven by the decisions of a limited number of players who have greater decision-making powers (e.g., shippers, receivers).
- Designing policies or strategies to foster behavioral shifts and efficiency improvements requires identifying the appropriate decision maker capable of influencing such change.
- The freight system is comprised of a number of supply chains, each with different operational patterns (e.g., distributive networks, spoke and wheel patterns, corridors).
- Freight activity manifests itself in different forms, depending on the layer of the economy: 1) international trade economy freight gateways (i.e., seaports, airports, land ports of entry); 2) domestic manufacturing/agricultural economy; and 3) the distribution and urban economy.
- Although usually overlooked, the freight traffic generated by the domestic manufacturing/agricultural and distribution economies is a magnitude larger than traffic generated by the international trade layers.

There are myriad types of efficiencies and inefficiencies worth discussion:

- The freight system experiences high levels of pressure from both external and internal factors. Government, market, and environmental conditions require the system's players to squeeze profit margins, in some cases, creating inefficiencies at the expense of other players and even at the expense of their own sub-systems.
- Due to the silo nature of the freight system components, efficiency gains at the sub-system level do not tend to equate to net gains in terms of a system optimum.
- Congestion, highway capacity, safety, geometrics, surface conditions, and intermodal connections are key concerns of the trucking industry.
- There are several corridors and freight bottlenecks affecting the efficiency of goods and passenger movements in different regions of the State.
- Congestion (in its various forms) is an important factor contributing to the system's inefficiencies.
- The share of accidents caused by trucks is small; however, accidents involving heavy-duty vehicles are more likely to result in fatalities.
- There are issues with truck routes and freight planning.
- Inefficiencies associated with the bulk of freight vehicle movements, and with the last mile and distribution economy, are the result of a lack of planning and consideration for the freight industry in general planning processes; the importance of the last mile and distribution economy has been neglected in particular.
- The general public and some public officials, usually associate the major freight issues with on-road motor carriers. However, these carriers are only the conduit between points of origin and destination; because of how the system works, shippers and receivers tend to be the ultimate decision makers that determine how, when, and where freight operations occur.
- Hours of Service Rules, especially the Hours of Service of Drivers Final Rule of 2011, if implemented, could introduce additional inefficiencies in the freight system.
- There are concerns in the trucking industry about the predicted shortage of qualified truck drivers.
- Within the seaports, congestion and inefficiency can be seen at the intersections of multiple portions of the supply chain and multi-modal transactions across multiple business lines, all in one concentrated node.
- Port labor disruptions during contract negotiations, and/or lack of new terminal infrastructure, can impact California's economic competitiveness.
- International cargo movement patterns that translate into congestion at seaports can also result in significant delays for trucks looking to pick up and drop off cargo. However, inefficiencies do not only affect the land side of marine terminals. Vessel loading and discharge is also susceptible to congestion, at a great expense to vessel operators.

In light of the Governor's Executive Order, it is imperative that California's various public agencies initiate, continue, and/or reinforce efforts to address freight efficiency issues such as those outlined above. These efforts should, in general, concentrate on:

- Conducting sound freight planning at all levels; with emphasis on urban freight.

- Identifying behaviors that need to be fostered, or mitigated, among the various stakeholders.
- Developing participatory stakeholder engagement.
- Fostering information sharing.
- Developing plans, agreements and platforms for active conversation to address labor issues; and invest in workforce development.
- Investing in research and continued improvement efforts.

In general, trying to achieve the goal of improving freight efficiency will require coordinated efforts between the public and private sectors, academia, communities, and any other relevant stakeholders. As there are numerous different types of issues identified within the freight system, it is not likely that a single strategy will result in significant improvements. This is a complex system requiring multi-part complex solutions.

Abstract

This paper (the first of a two-part series) discusses key findings from a collaborative effort between academia, public and private stakeholders, and government to identify strategies to improve the efficiency of California's freight system. In doing so, the paper provides a brief overview of the system, with an emphasis on key stakeholders, their roles and interactions, and implications associated with the types of freight movements and layers of the economy. Moreover, the work discusses major inefficiencies in the on-road trucking and maritime sectors, where congestion often impedes maximizing asset utilization. Part I presents a number of general recommendations to improve freight efficiency. Specific strategies are discussed in the second part of this series. In addition, this paper acknowledges the fact that it is not likely that any single strategy will result in significant-enough improvements on its own; the inherently complex nature of the system will require an equally complex set of solutions.

Introduction and Background

The freight system is one of the key contributors to a healthy economy. However, the vehicles, equipment, and facilities used by the different economic agents that conduct freight operations produce significant externalities including congestion, environmental emissions, and safety issues, among other impacts. Therefore, public and private initiatives, measures, or strategies to mitigate negative impacts and move the system towards a more sustainable path are a priority. In general, the type of strategies that could be implemented range from infrastructure improvements and technological advancements to freight transportation demand management strategies (which focus on behavioral changes). Although infrastructure and technology enhancements are essential components of a comprehensive improvement strategy, these alone cannot address underlying behavioral aspects that translate into system inefficiencies.

This concept is even more acute in a geographic location such as California, where important large traffic generators such as the maritime ports, international border, extensive agriculture and production lands, and huge consumption demand in its large metropolitan areas interact and exhibit diverse freight patterns, operations, and issues. The freight system experiences high levels of pressure from both external and internal factors. Government, the market, and environmental conditions require the system's players to squeeze profit margins, in some cases, creating inefficiencies at the expense of other players and even sub-systems. Moreover, efficiency gains at the various sub-systems do not equate to a system optimum. Therefore, putting forward a plan to improve the efficiency of the California freight system as a whole requires an understanding of its multiple stakeholders, industry relations, and the current opportunities and constraints faced by the system.

In this sense, Part I discusses some of the findings from the Freight Efficiency Strategy Development Group (FESDG). The FESDG is a collaborative effort between academia, public and private stakeholders, and government, sponsored by the California Department of Transportation (CALTRANS) and the Air Resources Board (ARB). A number of stakeholders have been convening since August 2015, with the ultimate goal of identifying inefficiencies faced by the freight system and putting forward a set of strategies to achieve a more efficient freight system. In doing so, a key first step was to provide insight as to the possible root cause(s) of major inefficiencies affecting the system.

In addition to assessing inefficiencies, this paper describes some of the aspects and necessary conditions that need to be considered when defining or identifying remediating strategies. Specific strategies are then discussed in a companion paper.

This paper is organized as follows. Section II provides a brief overview of the California freight system, emphasizing key stakeholders, their roles and interactions. Section III discusses major inefficiencies affecting the system. Section IV provides a summary and discusses crucial points to be considered in the development of improvement strategies.

Overview of the Freight System

Key stakeholders, their roles and interactions

At first glance, various stakeholders in the California freight system can be clearly identified. These include carrier companies (e.g., rail, ocean vessel, truckers, etc.); shippers; receivers (e.g., beneficiary cargo owners, retailers, manufacturers, farms, businesses, households); public agencies; terminal, distribution, warehousing and ancillary facility operators; intermediaries and logistics operators; regulators; the general public; trade organizations; unions; law enforcement; and, non-governmental organizations.

According to the California Freight Mobility Plan[1], the current core freight system includes:

- Twelve deep water seaports (11 private and 1 public),
- Numerous private port and terminal facilities,
- Twelve airports with major cargo operations,
- Two Class I railroads and twenty-six short-line railroads operating over approximately 6,000 miles of railroad track,
- Approximately 5,800 center-line miles of high-traffic-volume interstate and state highways,
- Three existing, and one future, commercial land border ports of entry (POE) with Mexico,
- Intermodal transfer facilities,
- Approximately 19,370 miles of hazardous liquid (includes crude oil, refined petroleum products, and other highly volatile liquids) and natural gas pipelines,
- A vast warehousing and distribution sector, and
- Numerous local connector roads that complete the “last mile.”

The sheer number of stakeholders (each with their own objectives, business models, regulatory compliance requirements, and areas of influence), makes describing their interactions, and even understanding the impact of efficiency improvement strategies, a daunting task. Within the system, there are numerous market forces that affect the way each individual player performs and the role that it plays; each subset of each supply chain aims to achieve the same end goal: to maximize its own utility and efficiency, and to minimize its own cost of doing

[1] California Department of Transportation, California Freight Mobility Plan (Final) Chapter 2.1 ~ 2.3, 2013.

business. It is important to note, as discussed before, that each individual player acting to maximize its own efficiency does not guarantee achieving a greater total systems efficiency.

At this point, it is important to mention that although all players may be performing inside a supply chain with many stakeholders, the performance of the chain may be driven by the decision of a limited number of them (having increased decision power). In many cases, the shippers and/or the receivers of the cargo are the ones defining the frequency of distribution, mode, routes, and even transaction schedules; with the rest of the players adjusting to these requirements. This highlights the need to fully identify these interactions when designing policies or strategies in order to reach the appropriate decision maker. In general, the effectiveness of any strategies will not only be their ability to address the key problem but also to reach the adequate stakeholder. For example, PierPass congestion charges are successful at shifting cargo from peak demand periods to off-peak demand periods mainly due to the system design where the fees were paid by receivers and not by the motor carrier drayage companies.

Cargo and Vehicle Movements

Describing the freight system requires defining the supply chains that comprise the system. The system does not drive freight; freight demand drives the system. Each supply chain system is made up of thousands of investments in companies, properties, public infrastructure projects, vehicles and pieces of equipment. The different stakeholders that are a part of each supply chain react to the demand for freight. This is the ultimate manifestation of the freight economy, where monetary transactions translate into the movements of goods (and the vehicles that carry them) from points of production to those of (intermediate or final) consumption. To put it in perspective, these manifestations which occur over and over again within the freight system contribute to one-third of the economy and direct and indirect jobs in California.

Most supply chains are distributive networks; others are formed in spoke and wheel patterns or corridors. Some are defined within the boundaries of the State while others span state lines. In some cases, products to be consumed, transformed, or exported in the State, may have already entered and exited the boundaries several times. Some flows of cargo pass through urban areas while others have the urban areas as the destination. This is of great importance since efficiency improvements will not only be needed inside the State but upstream in their out-of-state supply chains. In many cases, last mile challenges and inefficiencies hinder the efficiency gains in the long haul portion of the transport. These impacts will vary across different types of geographies and urban areas.

Without loss of generality, one can assume these areas to be comprised of different levels of three main layers of the economy where freight plays a role: the international trade economy, domestic manufacturing/agricultural economy, and the distribution economy:

- International trade economy freight gateways include seaports, airports, and land ports of entry. Usually, these operations concentrate along specific freight corridors connecting the port or border facilities and import or export facilities such as warehouses and distribution centers or manufacturing plants and farms.
- Domestic manufacturing/agricultural economy include users who build, grow, transform, and store goods. This is an important layer which drives a significant portion

of urban economies (the majority of the production centers are localized in or near urban areas).

- The distribution economy is related to the final consumption of the goods. Traditionally, the final recipients of goods were almost always freight intensive businesses, such as retail, wholesale, and food and beverage, but now direct residential deliveries constitute a growing and significant percentage of urban freight movements.

It is important to highlight that, although usually overlooked, the freight traffic generated by the domestic manufacturing/agricultural and distribution economies are of a magnitude larger than the international trade layers. Table *1* shows the estimated average daily truck trips in Southern California, with the internal[2] truck traffic representing almost 85% of the traffic. This is similar to the proportion of urban goods movements compared to major freight generators in other geographic locations.

Table 1: Daily Regional Truck Trips by Category by County[3]

	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	Total	Percent
Internal	10,002	550,207	174,631	89,910	112,434	45,781	982,965	84.8%
External*	2,061	47,992	8,046	4,231	7,601	2,347	72,278	6.2%
Port	14	50,585	1,460	659	1,897	104	54,719	4.7%
Intermodal (IMX)	6	5,430	284	197	1,610	44	7,571	0.7%
Secondary	2	5,986	307	128	1,206	20	7,648	0.7%
Total	12,085	660,200	184,728	95,124	124,748	48,295	1,125,181	
Percent	1.0%	56.9%	15.9%	8.2%	10.8%	4.2%		

** Does not include the trips between external to external SCAG zones (about 10,000 trips)*
Source: SCAG

Each of these economies brings a set of stakeholders and planning needs. Some are multi-modal in nature, while others are dominated by a single mode. Freight operations and patterns can also show a high degree of variability, depending on the composition (percentage of trade, manufacturing and distribution), imposing additional planning and modeling challenges.

While this paper will simplify the freight system in terms of these three layers, supply chains are complex and any further detail would require analysis of additional echelons or intermediary steps of the chain. Each of these layers will also exhibit distinct modes of transport, from large ocean vessel carriers transporting thousands of TEUs to cargo-bikes or even personal parcel deliveries at residential locations. Even at these different scales, the types of inefficiencies could be very similar, yet the approaches to solve them rather distinct.

[2] Internal Truck Trips: These are truck trips that have both an origin and a destination within the SCAG region and are generated by local industries, construction sites, domestic warehouses and truck terminals and residences.
[3] http://scagrtpscs.net/Documents/2016/draft/d2016RTPSCS_GoodsMovement.pdf

Inefficiencies in the Freight System

In general, inefficiencies in the freight system take the form of congestion, which in turn can result in higher levels of environmental pollution, additional safety conditions, and negative impacts on economic growth and investment.

Inefficiencies in the On-road Trucking Sector

According to a 1998 state survey of trucking firms,[4] congestion, along with highway capacity, safety, geometrics, surface conditions, and intermodal connections, was a principal concern of the industry. Since that time, growth in freight traffic, over the road or at specific freight bottlenecks have only caused more recurring and predictable congestion in selected locations; while the temporary loss of capacity, or nonrecurring congestion that is caused by incidents, weather, work zones and other disruptions, is still notably widespread even if less predictable[5].

In California, the major congested highways in the peak period are concentrated in its two largest urban cores, in the San Francisco Bay Area and greater Los Angeles. According to the corridor reliability buffer index, the least reliable corridors in 2010 were[6]:

- Westbound I–80, Alameda County, BTI[7]: 79 percent in the AM peak.
- Westbound SR–22, Orange County, BTI: 75 percent in the AM peak.
- Eastbound SR–91, Orange County, BTI: 74 percent in the PM peak.
- Northbound SR–57, Orange County, BTI: 70 percent in the PM peak.
- Southbound SR–57, Orange County, BTI: 67 percent in the PM peak.

According to the American Transportation Research Institute (ATRI), the Los Angeles metropolitan area had the highest cost to the trucking industry due to congestion with $1.1 billion added operational costs[8]. Specifically, the top 5 bottlenecks identified are listed below[9].

- SR-60 at SR-57 in Los Angeles County
- I-710 at I-105 in Los Angeles County
- I-10 at I-15 in San Bernardino County
- I-15 at SR-91 in Riverside County
- I-110 at I-105 in Los Angeles County.

[4] Regan, A. C., and Golob, T. F. (1999). Freight operators' perceptions of congestion problems and the application of advanced technologies: Results from a 1998 survey of 1200 companies operating in California. *Transportation Journal*, 57-67.

[5] U.S. Department of Transportation Federal Highway Administration, Freight Management and Operation, http://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/congestion.htm.

[6] California Department of Transportation, California Freight Mobility Plan (Final) Chapter 2.1 ~ 2.3, 2013.

[7] Buffer Time Index (BTI) is a reliability measure of travel time. Buffer Time is the difference between the average travel time and the 95th percentile travel time as calculated from the annual average. The Index is estimated considering a number of roadway sections (using VMT to weight the various) sections and controlling for the average travel rate across all the sections. In general, the measure could be explained as the extra BTI% travel time that a traveler should allocate due to variations in the amount of congestion delay on a trip.

[8] American Transportation Research Institute (ATRI). Cost of Congestion to the Trucking Industry. April 2014.

[9] American Transportation Research Institute (ATRI). Congestion Impact Analysis of Freight Significant Highway Locations. October 2014.

In addition, the reader is referred to the Goods Movement Appendix in the 2016-2040 Southern California Association of Governments' (SCAG) Regional Transportation Plan10 for detailed analysis of freight bottlenecks affecting the freight system in the region.

In terms of safety, the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS) reported that of the 2,758 total number of fatal traffic collisions in2010, 235 involved trucks (1 out of 10)[11]. Truck drivers were at fault in only 75 of the incidents, indicating that in fatal collisions between cars and trucks, automobile drivers are far more likely to be at fault than truck drivers. Similar proportions can be found when looking at injury collision statistics. However, though the share of accidents caused by trucks is small, accidents involving heavy-duty vehicles are more likely to result in fatalities.

Other inefficiencies can be associated with lack of information sharing. Some of these problems arise because of the silo nature of current operational patterns, and others stem from technical reasons. Still other transportation planning inefficiencies could take many forms, examples include issues with truck route planning, where the main problems are associated with: discontinuities between jurisdictions; lack of designated routes to developing or planned industry clusters; and wide divergences between designated and de facto truck routes.

The inefficiencies which are associated with the bulk of freight vehicle movements, the last mile and the distribution economy, are the inherent result of a lack of planning and consideration for the freight industry, in general, and neglect of the importance of the last mile and the distribution economy, in particular. Usually, this is the result of lack of visibility by Federal or Regional regulatory or management entities; in others because the "atomization" of the operations does not fall within the traditional definition of freight. This is both in terms of the cargo (volumes) and the vehicles or modes used. However, recent federal initiatives (STAA, ISTEA, SAFETEA-LU, MAP-21 and FAST) have increased the attention for the role of freight movements in urban and metropolitan areas.

On-road motor carriers, especially for-hire, both full truck load (FTL) or less than truck load (LTL) face challenges which are accentuated by the fact that the general public and public officials usually associate the major freight issues to their operations. It is perceived that these are the companies using the vehicles that generate congestion, parking problems, a disproportionate amount of emissions, and accidents (by severity and likelihood of resulting in casualties). However, because of how the system works, these carriers are only the conduit between points of origin and destination (explicitly shippers and receivers decisions) which are the ones that determine how, when, and where those operations occur. Developing strategies that solely focus on these stakeholders, which has been the traditional practice, will not take the system far enough as the additional costs and other system inefficiencies are mainly absorbed by these companies without affecting other legs of the chain.

In addition to the factors discussed before, two aspects represent a threat for efficiency improvements: hours of service rules, and driver shortages. These are discussed next.

[10] http://scagrtpscs.net/Documents/2016/draft/d2016RTPSCS_GoodsMovement.pdf
[11] California Department of Transportation, California Freight Mobility Plan (Final) Chapter 2.1 ~ 2.3, 2013.

Hours of Service Rules

Hours of Service (HOS) rules have topped the list of leading trucking concerns for the past few years (see Figure 1). In 2004, a 34-hour restart was first introduced in hours-of-service rules. HOS have been (and continues to be) revised over the years. The latest update (Hours of Service of Drivers Final Rule) was published in the Federal Register on December 27, 2011, with an effective date of February 27, 2012 and compliance date of remaining provisions on July 1, 2013.

Changes to the 34-hour restart and the 30-minute break were the biggest changes to be made since 2004. The updates added the following changes and provisions to the existing HOS rules:[12]

1) **1 a.m. to 5 a.m. Restart Provision:** a valid 34-hour off-duty restart period must include two periods from 1 a.m. to 5 a.m.
2) **One Restart per Week Restart Provision:** use of the restart is limited to one time per week (once every 168 hours from the beginning of the prior restart).
3) **Rest Break Requirement:** a driver may drive only if 8 hours or less has passed since the end of the driver's last off-duty or sleeper-berth period of at least 30 minutes.

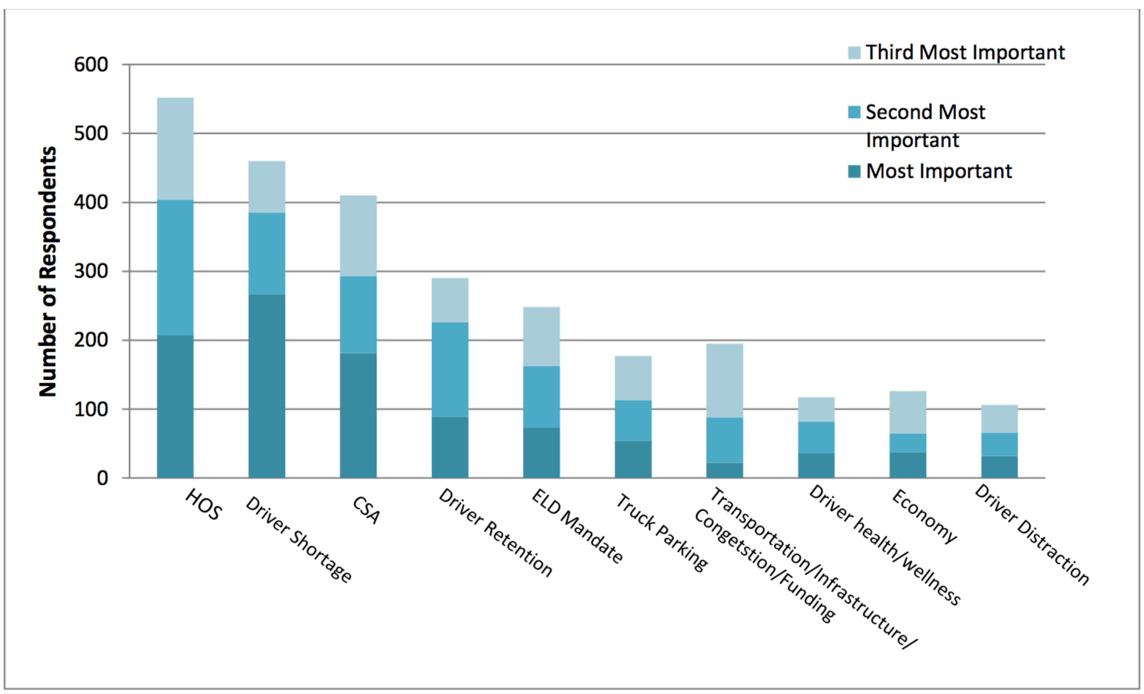

Figure 1: Distribution of industry issue prioritization scores[13]

[12] Federal Motor Carrier Safety Administration - See more at: https://www.fmcsa.dot.gov/regulations/hours-of-service#sthash.fMoFHwkP.dpuf

[13] ATRI (2014). Critical Issues in the Trucking Industry. http://atri-online.org/wp-content/uploads/2014/10/ATRI-2014-Top-Industry-Issues-Report-FINAL.pdf

The Final Rule, however, was suspended in December 2014. Congress suspended the changes to the restart provisions after trucking groups complained regulators didn't complete a study when developing the rules. Changes, especially the 2 consecutive 1-5am breaks, were broadly opposed by trucking interests. Regulators argued that the rules were meant to increase safety and reduce excessive work hours. The trucking industry claimed that shifting work hours to hours of greater congestion is more risky and that regulators failed to study this properly.

It is imperative that the State carefully addresses the potential negative impacts that the Hours of Service rules can have for freight efficiency, because the enforcement of the restart provisions of the Final Rule would introduce significant inefficiencies in the California Freight System. For instance, it would make difficult for some of the operators that want to participate in extended hours or off-hours operations as it will limit their early travel almost twice per week. Considering the uncertainty in trucking freight operations, the rule could greatly reduce the efficiency of trucking carriers and impede the achievement of the mandate of the Governors' Executive Order. Figure 2 shows a clear example of the inefficiencies that could be introduced by the rule. Depending on the scheduling, the restart rule could translate in a minimum of 1 hour lost and maximum of 17 hours for every restart. This is a major inefficiency as the 34 hour restart rule could become 51 hours. In some cases, due to differences in time zones, this could mean even longer down times. Parking availability is another factor that should be analyzed when evaluating the HOS rule.

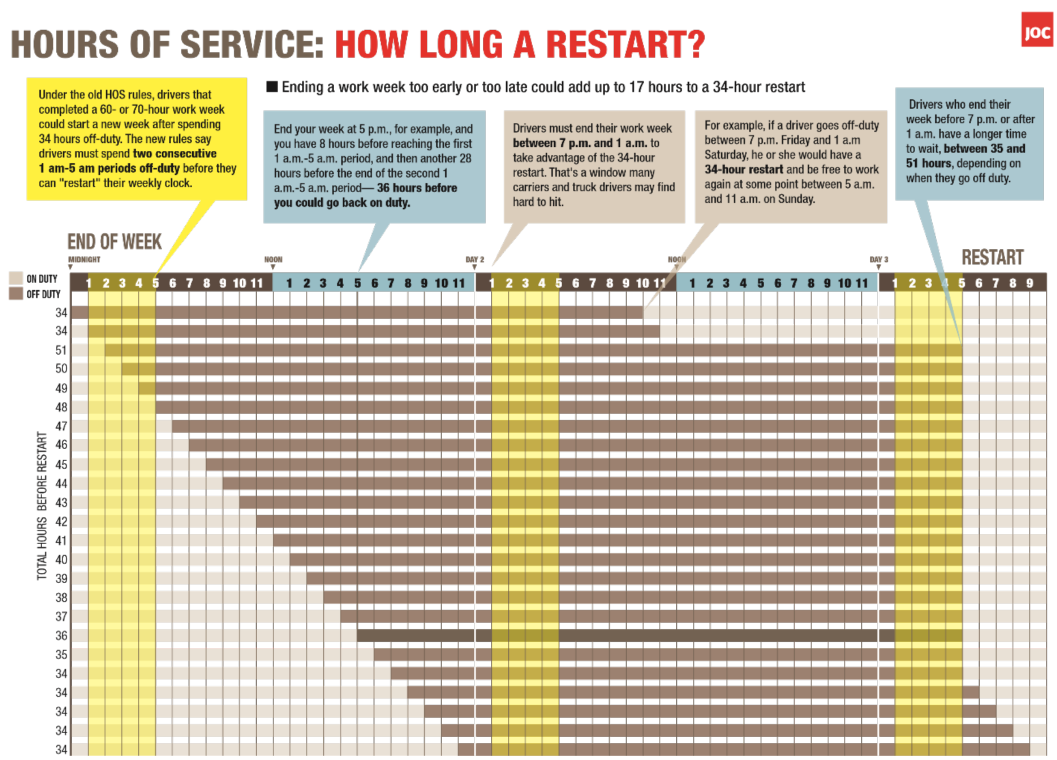

Figure 2: The impact of Hours of Service Rules[14]

[14] http://www.joc.com/sites/default/files/u48502/InteractiveGraphics/HoursOfServiceRestartChart.pdf

As a result of the concerns, a study was ordered and scheduled to be reviewed by the U.S. Federal Motor Carrier Safety Administration (FMCSA) and Congress. This report is still pending as of February 2016. Recently, the FMCSA eased concerns that the suspension would be lifted and rules would be reinstated this year. This has been referred to as a regulatory "snapback", and is feared and opposed by trucking and shipping interests. The suspension cannot be lifted until Congress receives the agency's report, but it has been somewhat unclear whether the FMCSA can simply reinstate the suspended rules after the report is delivered, or if Congress must act first.

Concerns associated with trucking hours of service rules include limited productivity and compensation issues. Congress's suspension of the provisions is credited with freeing up as much as 1 to 3 percent of truckload capacity in 2015[15]. "…Team operations were probably most affected…," said Bill Matheson, president of intermodal and logistics services at trucking firm Schneider. "…The rollback gave them probably 2 to 3 percent of their productivity back..." It is also believed that studies are likely underestimating the negative impacts as well, since some drivers may have been cheating the system in order to avoid productivity losses, thus softening the impact seen in reported numbers. In terms of compensation, all truckers are majorly concerned with the possibility of fewer worked hours due to hours of service rules.

Driver Shortages

In addition to hours of service rules, another concern related to labor in the trucking industry is the predicted shortage in qualified truckers. Hiring isn't up, or at the same rate as in past, and retirements mean the loss of experienced drivers.

The key findings from recent reports and news about the driver shortage problem include[16,17]:

> "…Over the past 15 years, the trucking industry has periodically struggled with a shortage of truck drivers
>
> In 2014, the trucking industry was short 38,000 drivers. The shortage is expected to reach nearly 48,000 by the end of 2015. If current trends hold it is expected to grow to 175,000 by 2024.
>
> There is also a concern of quality, in 2012, 88% of fleets said that most applicants were simply not qualified.
>
> Over the next decade, the trucking industry will need to hire a total 890,000 new drivers, or an average of 89,000 per year. Replacing retiring truck drivers will be by far the largest factor, accounting for nearly half of new driver hires (45%). The second largest factor will be industry growth, accounting for 33% of new driver hires.

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[15] http://www.joc.com/trucking-logistics/labor/hours-service-snapback-put-doubt_20150922.html

[16] American Trucking Association (2015). Truck Driver Shortage Analysis. http://www.trucking.org/ATA%20Docs/News%20and%20Information/Reports%20Trends%20and%20Statistics/10%206%2015%20ATAs%20Driver%20Shortage%20Report%202015.pdf

[17] http://www.joc.com/special-topics/driver-shortage

Of the 7.1 million people employed throughout the economy in jobs related to trucking activity, 3.4 million were truck drivers in 2014. There are over 10 million CDL (Commercial Driver's License) holders in the U.S., but most are not current drivers and not all are truck drivers. There are between 2.5 million and 3 million trucks on the road today that require a driver to have some sort of CDL. Of those trucks, 1.6 million are tractor-trailers. Of those tractor-trailers, no more than 800,000 are used in OTR (i.e., non-local) operations.

The bulk of the driver shortage is for over-the-road (i.e., non-local) drivers operating heavy-duty tractor-trailers (i.e., Class 8 tractors), for-hire truckload sector.

It is highly unlikely that the driver shortage could be reduced in any significant manner through modal shift

Truck driver hours-of-service, reduce industry productivity. Reductions in productivity exacerbate the driver shortage as it requires more trucks, and thus more drivers, to move the same amount of freight…"

In addition, under federal law it is illegal to organize independent drivers. However, advocacy groups such as the teamsters have been organizing drivers under suits claiming "misclassification" as independent contractors. Over the past several years, teamsters and truck drivers have won some lawsuits in CA and some drivers have even been awarded some back wages. Three government agencies (the California Labor commissioner, the regional office of the National Labor Relations Board and the California Employment Development Department) have issued rulings. Unions can legally attempt to organize direct employees, so court victories such as those mentioned above could potentially have a growing impact on the drayage industry. One strategy, in addition to legal action, has been picketing and withholding of driver services, causing delays for all sections of the port system.

Inefficiencies in the Maritime Sector

Within the seaports, congestion and inefficiency are reflected in the intersection of multiple portions of the supply chain and multi-modal transactions across multiple business lines, all in one concentrated node. To illustrate the many business stakeholders involved, Figure *3* shows a dynamic pyramid, with everyone's ultimate customers–the shippers and receivers–on top. These cargo owners determine, in most cases, shipment sizes, frequencies, modes of transport, delivery and transport schedules and locations, and most importantly the demand and the prices that will be paid for services across the intermodal spectrum. At the next layer there are ocean vessel and rail carriers. Their immediate contractual privity to the shippers allows them to have a more dominant role along the chains than port terminals and drayage trucking transport operators. Marine terminal operators and public port authorities maintain highly-leveraged and intensive capital investments, which limit market entry conditions, and are dependent on the cargo volumes provided by ocean and rail carriers, which are demanded by shippers.

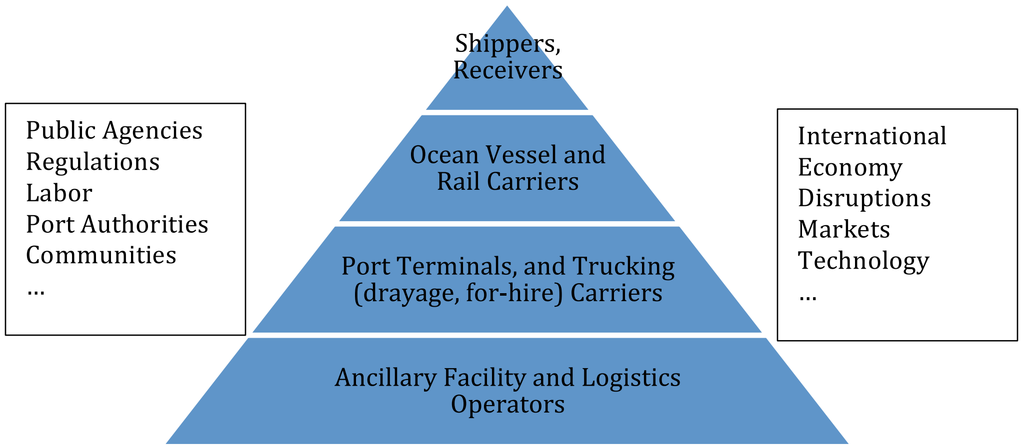

Figure 3: Key Stakeholders of the Freight System

However, the relationship between ocean carriers and port terminal operators is facing increased challenges, especially due to external factors driving changes within the system such as labor, alliances, and congestion at the facilities. For example, recent labor shortages at the main (West Coast) ports due to contract negotiations (about 20,000 dockworkers) accounted for 80% of a bottleneck that impacted 36 vessels idling at sea[18].

More challenges are posed in the development of ever larger vessels, which can boost vessel operating efficiencies, as well as the increased use of Vessel-Sharing Alliances (VSAs), with most major ocean carriers operating in VSAs of two to six member lines. The direct efficiencies from the vessels are well documented, i.e., > 18,000 TEU vessels provide 50% of more energy efficiency.[19]

Port labor disruptions during contract negotiations and/or lack of new terminal infrastructure can impact California's economic competitiveness. For instance, the impacts in 2014/15 during the protracted contract negotiation resulted in short- and long-term impacts affecting the system whereby many beneficiary cargo owners adopted a "four corner logistics strategy" to diversify their supply chains in order reduce future vulnerability to labor disruptions at the San Pedro Bay ports. The "four corner logistics strategy" introduces redundancy in supply chains by not concentrating on Southern California, but rather one which relies on seaports in all "four corners" of the U.S. (i.e., southwest, northwest, northeast, and southeast).

Congestion at seaports can also result in significant delays for trucks looking to pick up and drop off cargo[20,21]. Trucks can experience major delays just waiting for dispatch to a seaport, in

[18] Bloomberg business (2015), "Port Deal Near as One Issue Remains, Long Beach Chief Says", February 11, http://www.bloomberg.com/news/articles/2015-02-11/port-deal-near-as-single-issue-remains-long-beach-chief-says, accessed October 2015

[19] Kindberg, Lee (2015), "Delivering Sustainability: Ocean Shipping and Supply Chain Efficiency", University of California, Davis, webinar, October 1st.

[20] Giuliano, G., Hayden, S., Dell'aquila, P., & O'Brien, T. (2008). *Evaluation of the terminal gate appointment system at the los Angeles/Long beach ports* (No. METRANS Project 04-06). METRANS Transportation Center.

[20] California Department of Transportation, California Freight Mobility Plan (Final) Chapter 2.1 ~ 2.3, 2013.

addition to queueing outside the terminals and waiting time spent inside the terminals when conducting their transactions. Overall, time spent waiting is a significant inefficiency. This has a direct impact to drayage operations, and represents an opportunity to achieve efficiency improvements.[22] Although truck queues and congestion at port terminals gates generate inefficiencies and other externalities, terminal operators serve their primary customers which are the steamship lines and major import/export companies by managing their internal dock operations under their longshore work rules, leases and contracts, and other constraints[23]. However, inefficiencies not only affect the land side of these terminals. Vessel loading and discharge is also affected at a great expense to vessel operators.

Summary and General Recommendations

The previous sections discussed some of the key characteristics of the California Freight System. Specifically, the types of stakeholders involved, their dynamic relations, and a number of inefficiencies affecting the system. In light of the Governor's Executive Order, it is imperative that the various public agencies in the State initiate, continue or reinforce efforts to address some of these issues. In general, these efforts should concentrate on:

Conducting sound freight planning at all levels

California is a diverse geographic location in terms of freight, with various requirements and constraints throughout the State. To improve the efficiency, planning should be conducted addressing the needs of the different sectors and layers of the economy. Although, the international trade economy gateways attract much of the attention and can dominate the planning agenda, the domestic manufacturing/agricultural and the distribution urban economies play a key role in the freight system. Consequently, planning resources are required at all levels, from the large Metropolitan Planning Organizations to the local jurisdictions. It is important also to recognize that across all the sectors and economies, congestion (in its various forms) is a key factor that hinders maximizing asset utilization, and should be a priority for planning organizations. Urban freight is also plagued with many inefficiencies such as lack of parking infrastructure, conflicting regulations, and higher costs of conducting business in many large dense areas.

Planning efforts will allow identifying the types of freight behaviors that need to be fostered or mitigated among the various stakeholders

These behavioral changes, will require in most cases, the design of effective incentive programs. These programs could include adequate recognitions programs, financial or non-

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[21] Barber, D., & Grobar, L. M. (2001). *Implementing a statewide goods movement strategy and performance measurement of goods movement in California*. METRANS Transportation Center.

[22] Haveman J. and K. Monaco (2009). Comprehensive truck management program: economic impact analysis. Available from: http://www.portofoakland.com/pdf/maritime/ctmp/ctmp_Beacon_Final.pdf?utm_source=redirect&utm_medium=old_site_request

[23] Giuliano, G., & O'Brien, T. (2007). Reducing port-related truck emissions: The terminal gate appointment system at the Ports of Los Angeles and Long Beach. *Transportation Research Part D: Transport and Environment*, *12*(7), 460-473.

monetary assistance, or pricing and taxation type of schemes. There are a number of programs in the State trying to achieve higher levels of sustainability. However, these programs do not fully consider operational or logistics changes, and for the most part, concentrate on technological improvements.

Participatory stakeholder engagement

Each individual stakeholder is or has invested great efforts to improve how they operate. Every company has an incentive to invest in technology, planning, and infrastructure in order to streamline their operations and to be more efficient given the pressures of the supply chain. In order to continue being competitive in a market where rates are at their lowest, companies are required to operate with high levels of sophistication and planning. However, while each individual company, industry, or mode is organizing itself in ways which are most effective and efficient for itself, the supply chain as a whole may still benefit from some third-party incentives which create even greater system efficiency. This in turn, requires the development of system level performance measures that are conducive of system-wide efficiencies.

Currently, there are already ongoing efforts for supply chain optimization and port optimization which are resulting in significant improvements and efficiency gains. For example, the Port of Long Beach's Green Port Gateway project, funded by federal and local sources, was finalized in 2015. The main purpose was to improve tracks' infrastructure to enhance rail efficiency and expand on dock capacity in the Port of Long Beach to haul cargo containers directly to and from marine terminals[24]. As a result, 750 truck trips will be avoided by each train. The Port of Long Beach has established a goal of moving 35% of containers by rail in the next 5 years while aiming to achieve a long term target of 50%[25]. The Port of Los Angeles policy is similar: to provide as much rail infrastructure as necessary, and facilitate intermodal logistics such that the movement of direct intermodal cargo (approximately 40-50%, depending upon terminal and steamship line) via on-dock rail is maximized to the greatest extent possible. The results from efforts such as these, highlight the important to recognize the role that planning, collaboration and cooperation, and incentives can have to further produce multi-modal and supply chain efficiencies. Considering how diverse each stakeholder's operations can be, with their own constraints and opportunities, developing appropriate strategies requires insights and detailed analysis of how each supply chain operates. Often this is information that only specific industry experts can provide.

Fostering information sharing

It is important to develop the mechanisms to foster information sharing. Whether it is through Strategy Development Groups, Task Forces or any other collaborative spaces, public agencies should actively engage the various stakeholders in the freight and other sectors to fully identify

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[24] Port of Long Beach (POLB) (2015c), "Green Port Gateway Rail Project: Fact Sheet", http://www.polb.com/civica/filebank/blobdload.asp?BlobID=10973, accessed October 2015

[25] Railway technology (2015), "California's Port of Long Beach completes $93m Green Port Gateway rail project", September 18, http://www.railway-technology.com/news/newscalifornias-port-of-long-beach-completes-93m-green-port-gateway-rail-project-4673539, accessed October 2015

the key problems, and develop sound solutions. Furthermore, information sharing may not only be incentivize for planning purposes, but also to recognize the value of information as an input and output to operational processes. All stakeholders participating in this Freight Efficiency Strategy Development Group (FESDG) have identified the need to manage information flows, thus developing information technologies and infrastructure are a must. However, it is also important to understand the full implications of these efforts, because of the very value of information. The resolution of the data, privacy concerns, open or controlled access, the structure of the managing agency, and the validity of the sources, are just a few among the number of factors that need to be addressed when developing such information systems and sharing practices.

Other

While a companion paper focuses on specific strategies to improve asset utilization, it is also important to highlight the need to develop plans, agreements and engage in conversations to address labor issues to optimize such resources. Labor difficulties impact all facets of freight, from modes to facilities. While some of the inefficiencies may be driven by safety concerns and the associated regulations, it is important to consider the full spectrum of impacts that regulations and decisions can have across other operational and tactical factors. Labor issues, such as driver shortages, could also be addressed by investing in workforce development.

Investing in research

In general, trying to achieve the goal of improving freight efficiency will require coordinated efforts between the public and private sectors, academia, communities, and any other stakeholder. It is not likely that a single strategy will result in significant improvements. This is a complex system requiring complex solutions. As a result, it is important that public and private agencies and organizations support research efforts that can help shed light into the various complex issues affecting the system and potential specific solutions.