

MIT Center for Transportation and Logistics (CTL)

Innovations in Transportation 2006
Finding Capacity: Short- and Long-Term Solutions

Cambridge, MA

May 16-17, 2006

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1. Introduction to Report

The MIT Center for Transportation and Logistics (CTL) held the 3rd annual Innovations in Transportation Symposium on 16-17 May 2006. Over 60 transportation experts from all aspects of the industry spent a day and a half discussing current capacity issues and working through interactive exercises designed to stimulate brainstorming.

This year's symposium focused on how shippers, carriers, government agencies, and other players within the transportation industry can improve overall system capacity. Opinions differed and the debate was lively – with all attendees participating in the discussions.

The objectives of the symposium were two-fold. First, it was hoped that through discussions a number of solutions, strategies, and approaches to alleviate or mitigate uncertainties on both the supply and demand sides could be identified. Second, the participants were challenged to broaden their perspectives. Speakers and attendees came from a wide variety of background and represented the shipper, carrier, government, academic, labor, and infrastructure perspectives.

The remainder of this report is organized as follows. Section 2, Synthesis, ties together the major themes of that came out during the day and a half of discussions, presentations, and debate. Section 3 presents summaries from each of the presentations and the ensuing discussions.

2. Symposium Synthesis

This section provides an overview and synthesis of the concepts and issues covered over the course of the symposium.

2.1. Causes of the Capacity Crisis

MIT surveyed over 500 transportation professionals from shippers, carriers, 3PLs, and government organizations. The survey asked about causes of the capacity crisis, impacts of the crisis, and corrective actions. In general, respondents from the government had a long-term view with a focus on infrastructure, while shippers and carriers had a more short-term view focused on operational issues. The MIT Infrastructure Survey Report is available from CTL. This survey, and the presentations at the symposium, highlighted several root causes of the capacity crisis.

2.1.1. Fast-Growing Trade vs. Slow-Growing Capacity

Booming international trade, especially imports from China, has placed tremendous and growing stress on the U.S transportation network. Participants noted that the shift of manufacturing to China is far from over. According to a recent survey by Deloitte, some 55% of North American manufacturers and 39% of European ones are planning to enter or extend their operations in China. International trade is expected to grow from 21% of the U.S. GDP in 2002 to about 33% of GDP in 2012. And because the GDP itself will grow, the result is double-digit growth in freight volumes for the foreseeable future. This level of trade means growing volumes at U.S ports, especially those on the West Coast such as LA/Long Beach. Some economic forecasts call for slowing growth later in 2006, but it is still growth. Moreover, the last four months of the year always bring added volume as retailers stock shelves for the holidays.

Against this backdrop of double-digit freight growth is the much slower growth of infrastructure capacity. Growing Asian trade places a special burden on both sea and land infrastructure as West Coast imports must be moved to East Coast population centers. The MIT Transportation Infrastructure and Capacity Survey found that truck driver shortages and West Coast port congestion ranked high as causes of the crisis.

2.1.2. Tighter Peaks

Exacerbating the capacity problems are the increasingly tight replenishment processes used by shippers and their customers. Wal-Mart, for example, tells suppliers on Monday at noon what deliveries it wants to receive by Friday of that week. In addition, rather than have a slow build of retail inventory for the holidays, retailers now run on-demand systems that pull last-minute delivery of holiday volumes of goods. Trucking and port capacity that suffices for seven months of the year is scarce in the last quarter. Other lumps in the flow occur for a myriad of reasons, such as the surge in consumer spending that occurs after consumers receive their monthly paychecks. Another surge occurs at the end of the quarter, as salespeople scramble to meet sales quotas.

2.1.3. Cost-Cutting

Several participants blamed some of the current problems on years of cost-cutting and aggressive bidding practices by shippers in the post-deregulation transportation environment. Trucking companies as well as railroads faced a long buyer's market. Railroads, for example, had years of low or negative returns on investment for track and rolling stock. Many railroads stopped replacing low-ROI rolling stock and divested miles of track in the aftermath of the deregulation. As one railroad put it, "there was no ROI for putting money in the dirt" for many years.

Underfunding has also occurred in the public sector. According to the MIT survey, government transportation officials were especially concerned about under-investment in infrastructure by railroads, state governments, and the federal government. Inadequate funding for the DOT means a steady maintenance deficit and growing maintenance debt. The USDOT estimated it may take nearly half a trillion dollars in the coming years to refurbish the existing infrastructure.

2.1.4. More Regulations

Increasing regulations threaten capacity in at least two ways. First, the twice-changed, still unsettled Hours-Of-Service (HOS) rules for truckers pose a challenge to driver productivity. The fewer the hours on the road, the fewer the miles, and the lower the velocity of freight. Restrictive HOS rules reduce the productivity of an already-tight driver workforce.

The second, and potentially most serious under-appreciated, threat seems to be the new TWIC (Transportation Worker Identification Credential) regulations that call for security IDs for transportation workers. The new rules call for background checks and proper documentation on truckers and longshoremen but could also affect other logistics workers, even those on the loading docks. Symposium participants wondered about the fraction of these workers that have less-than-desirable backgrounds or who might be unwilling to have their privacy violated. One participant noted that the day the INS (Immigration and Naturalization Service) went to the yards of LA/LB, many trucks were idled. Stricter regulations will remove a number of current workers from the job force and create more obstacles to recruitment and hiring.

2.1.5. Demographics

CSX also raised the issue of an aging workforce, pointing out that 70% of its workers would be retiring in the next few years. Some participants expressed concern about the productivity of the next generation of truck drivers. As one participant put it, parents aren't urging their kids to become long-haul truck drivers. Currently, trucking companies seem to be poaching drivers from each other rather than creating the next generation of drivers.

Although many complained about the truck driver shortage, they acknowledged that the shortage really only affects long-haul point-to-point trucking. Few people want a nomadic lifestyle that keeps them away from their families for weeks at a time. In contrast, companies with short-haul circuits and more regular routes that give drivers time at home have fewer hiring and retention problems. This distinction between scheduled and irregular operations can lead to potential technical or managerial

approaches to combat high turnover at long haul trucking firms. If quality-of-life issues for long-haul truckers aren't addressed, there will be fewer applicants, higher turnover, higher salaries, and lower productivity.

2.2. Solution Process

Throughout the symposium, the speakers and participants discussed various strategies for increasing freight capacity. These strategies provide tools for solving the problems that transcend the specific short-term, medium-term, and long-term solutions to capacity problems.

2.2.1. Systems Thinking

Several presenters and audience members noted the systems nature of the problem: that the true capacity of our freight transportation system depends on all the interconnected components. Improving capacity means more than just making everything bigger. One presenter likened it to sizing a pump for a swimming pool. The best pump size depends on multiple factors, such as the size of the pool, the piping, and the filters. Bigger isn't always better if it consumes limited budget, strains other parts of the system, or fails to address the true choke-point limit of the system.

Organizations are analyzing their companies to better understand how they can increase capacity. For example, the Port Authority of NY/NJ reviewed the three areas of port operations: berth, container yard, and gate areas. Boosting berth crane productivity does nothing if terminal yard operations run out of land. Maximizing containers per acre would mean nothing if gate operations create a bottleneck. The systems issues also occur in land-side freight infrastructure. Improvements in rail operations do nothing if intermodal interconnects run over deteriorating roads and bridges.

2.2.2. Collaboration

Due to the multiple owners and stakeholders in freight transportation systems, collaboration underpins many solutions to capacity problems. Three of the top five actions that shippers are taking, according to the MIT survey, involve greater collaboration with carriers. Collaboration is an extension of these organizations' recognition that freight transportation is a system that calls for a coordinated, system-wide response to capacity problems.

Because freight transportation crosses jurisdictional boundaries, solving capacity problems requires regional collaboration. Most infrastructure capacity limits have a regional scope -- a geographic stretch of road, rail, or water that transcends single metropolitan area, congressional district or state. Moreover, the shippers, carriers, and customers that rely on the infrastructure also cross political boundaries. For example, P&G is concerned about congestion that spans its network, from its factories and DCs around Cincinnati to population centers along the Eastern seaboard. For public officials, the challenge is how to fund systemic improvements in infrastructure that address non-local needs and provide benefits outside of the local tax-base. Future research might help uncover the best ways to define and manage transportation systems that cross political boundaries.

Collaboration implies shared costs and shared benefits. Both the Southern California Association of Governments and the Port Authority of NY/NJ have done analyses to ensure that the added user fees levied to pay for an improvement project don't exceed the net benefits of the infrastructure improvement. Price elasticity issues mean that the higher the costs of using a port or mode of transportation, the lower the demand for that mode. If a port operator or authority, for example, charges too much, then shippers and carriers will reroute freight to other ports or modes. The key, for all parties, is to understand and document the costs and benefits to ensure mutually acceptable solutions. Other organizations, such as Staples, use gain-share programs as part of carrier management to ensure that both parties benefit from improvements in freight transportation.

Collaboration can also mean understanding the alternatives for fixing specific capacity limitations. For example, the Bayonne Bridge provides a clearance of only 151 meters, which is not sufficient for the masts and even the stacks of some of the largest container ships. Raising the bridge has an estimated cost of \$600 million. In contrast, modifying the ships to have a flip-down mast and stacks might cost only a quarter of a million per ship. NY/NJ is trying to show ocean carriers the advantages of converting their ships to pass under the current bridge.

Collaboration needs to also occur between the private and public sectors. While shippers and carriers alike cited investment in highways as the number-one funding priority, two-thirds of shippers and about half of carriers indicated that they have *never* met with federal, state, or local government transportation authorities. Even the carriers, who are the direct users of public infrastructure, seldom meet with government officials more frequently than annually. Although participants noted that many large companies may have centralized government relations departments that were not surveyed by MIT, it's unclear whether these departments are aware of transportation issues.

One core challenge to motivating government investment and freight-friendly regulations is the fact that "freight doesn't vote." Moreover, when it comes to ocean shipping, the fact that all the carriers, such as APL, are foreign-owned companies places limits on lobbying the U.S government. This means freight gets short shrift during budget discussions. As one speaker put it, "when it comes to government funding decisions, you are either at the table or on the menu." Thus, domestic shippers and customers need to become more involved in lobbying for better policies and investment schemes. One such group is a domestic policy group formed by APL's customers, which now has nearly a dozen members representing \$343 billion in annual revenues and over 1.5 million employees. By joining together, companies and their employees can become a more powerful political force. Unless public officials and the public at large understand the deleterious impacts of well-meaning decisions, they are unlikely to consider the needs of transportation.

Better collaboration can help. For example, one MPO solicited feedback from companies about problematic roadways and intersections. Several companies identified one especially congested intersection in which simply lengthening the left-turn lane and left-turn light duration solved the problem. The point is that government officials can make more effective use of limited funds with input from shippers and carriers.

The government is also working to better understand the needs of the freight industry. The USDOT created the TRB Freight Industry Roundtable to better understand supply chain issues and to facilitate a dialog between industry and the USDOT. The USDOT is also working on a comprehensive National Freight Policy featuring seven interrelated objectives that address issues ranging from new infrastructure to better regulatory structures to improvements in security and environmental issues. As part of its collaborative efforts, the USDOT created a website that lets organizations create and own tactics that support freight policy objectives.

2.2.3. Scenario Planning

The second day of the symposium featured a scenario planning exercise as part of ongoing Supply Chain 2020 research project. Scenario planning differs from traditional planning processes. Whereas most planning processes focus on projecting a single highest-probability future state, scenario planning considers multiple divergent, yet plausible, futures. Furthermore, whereas most planning processes emphasize numerical forecasting with plus/minus boundaries on the variables, scenario planning emphasizes qualitatively different futures.

MIT's SC2020 research project is leveraging scenarios created by Shell Oil's long-running scenario planning group. Three plausible future scenarios are discussed. Each scenario differs in terms of the relative dominance of the three major socio-economic forces: government, community, and markets. Each of the three scenarios is a potential world where two of the three forces dominate the third.

The "Alien Nation" scenario is one in which government and community interests overshadow those of global business. Some called this scenario "Old Europe," because local concerns trump efficiency as countries wall themselves off. The "Spin City" scenario sees the rise of governments and markets over the needs of communities. Global trade occurs in the context of a complex web of regulation in what some likened to current-day Washington D.C. The "Synchronicity" scenario has strong markets and community forces in an environment of weaker, highly-democratic government. Low levels of local government regulation lead to high levels of global trade and innovation in what one person called "Happy World." Although some participants quibbled about the likelihood of the scenarios, the point is that each is potentially plausible depending on the relative strengths of governments, markets, and communities.

Symposium attendees were divided into three groups and were assigned to "live" in one of these scenario worlds. Within the context of its future scenario, each group considered five questions to understand the implications for freight transportation of that potential future. Each group discussed infrastructure, technology, sourcing, the organization of transportation, and regulations within the context of its particular scenario. Following the breakout sessions, the attendees came together to present the implications of each scenario and discuss the results.

Scenario planning yields two types of implications. The first category is robust implications -- actions that a company definitely should or definitely should not take, regardless of the future. The first type of these robust implications are called "no-brainers" because they provide a positive outcome regardless of scenario. For example,

every group saw the value of visibility regardless of which scenario comes to pass. Thus, investing in improving visibility is a good decision under any scenario. Another type of robust implication is a "no-regrets" implication. "No-regrets" implications provide positive returns in some scenarios and a neutral outcome in other scenarios. For example, security was mandatory in two of three scenarios but was not without some benefit in the third. Finally, a robust implication can be a "no-gainer" that creates problems regardless of scenario. Companies can cease investing in activities identified as "no-gainers." The point is that an organization can take action on robust implications without knowing exactly which scenario may come to pass.

The second category of implications is termed contingent implications -- actions that may have a high payoff in one scenario but negative consequences in another scenario. Contingent implications drive the development of "sensors in the ground" in which the organization monitors the environment to detect the rise of one scenario or another. For example, seaport and airport infrastructure investments were contingent implications because they would be unnecessary in the low-trade "Alien Nation" scenario.

2.2.4. Visibility: Who Knows What

The need for better visibility was a robust implication of the scenario planning exercise; regardless of the future, better visibility is important for a range of objectives, such as effective use of limited capacity, low-cost freight operations, and security. Visibility underpins collaboration because different parties have crucial data on different parts of the freight transportation system. Shippers know the pattern of supply volumes, customers know the pattern of demand volumes, carriers know the deployment and availability of assets, and government knows the condition of major sections of infrastructure and capacity-modulating factors (e.g., weather and construction). Some participants suggested that shippers need to better coordinate with each other to help reduce deadhead miles and to jointly optimize networks to balance regional freight flows.

Visibility works on multiple time-scales. To coordinate day-to-day freight movement, organizations need to consider long-term issues. For example, facility operators need to understand long-term carrier equipment trends. Thus, the Port Authority of NY/NJ asked major ship owners and operators about their vessels' dimensions to better understand the port's needs for water draft and air draft. The shift toward larger and larger vessels means the potential need for new infrastructure or adjusted practices.

New transducers and the widespread use of GPS receivers on tractors and even trailers provide a new opportunity for managing infrastructure capacity. Currently, the DOT is tapping into this data to understand real-world highway flow and bottlenecks. Next, the DOT is interested in leveraging real-time data that would help government transportation managers and emergency response workers catch developing congestion. Private satellite communication companies are interested in gathering and reselling the data to help trucking companies do real-time rerouting around unexpected delays.

2.2.5. Overcoming Resistance

Some ports and transportation facilities suffer space constraints; residential, urban and industrial developments have surrounded the facilities. Moreover, many ports sit in the middle of busy urban areas that now have extremely high land prices. One participant

joked about New Jersey being the nearest affordable land for Boston's warehousing needs.

Attempts to expand port transportation facilities, especially in California, have been met with vociferous opposition by community groups. Local NIMBYs (Not-In-My-Back-Yard) have been joined by BANANAs (Build Absolutely Nothing Anywhere Near Anybody) to hinder all manner of infrastructure development projects. These groups protest on the basis of air quality, noise, and congestion without regard to the long-term economic impacts. Yet rather than try to hide from these groups, one government representative recommended up-front positive engagement with them.

The issue of community resistance to new infrastructure is also a land-use issue. Too often, residential neighborhoods have filled in the space around logistics facilities. Improvement in infrastructure attracts development, including residential development. Development creates more traffic, which leads to the same congestion that spurred the original improvements. Ironically, the development of new infrastructure attracts a community that then hinders both the effective operation and further development of that infrastructure. Better land-use policies in the context of new infrastructure development would help ensure a better separation of commercial and residential uses and ensure that logistics facilities have room to grow.

2.2.6. Funding

Many solutions require millions or billions of dollars, which raises the issue of who pays for it. The results of the MIT survey showed a surprising consensus on the need for a mix of public and private funding for a wide range of projects. Neither side insisted that the other party pay the entire bill for critical infrastructure improvements. Participants mentioned a number of public-private funding schemes such as government-backed bonds, user fees, Cargo Facility Charges, investment tax credits, and so on. There is even the possibility of private highways -- for example, a Spanish company recently purchased a toll highway in Chicago.

One model, advocated by NY/NJ, is a Cargo Facility Charge model that levies a nominal user fee on all cargo to support specific improvement projects. Modeled on the FAA's Passenger Facility Charge program, the Cargo Facility Charge would include a combination of government oversight and user approvals to help fund investment rather than be just another means of covering operating costs. In general, user fees appear to be a way to charge for-profit companies for their fair share of the use of public infrastructure.

During the scenario planning exercise, attendees specifically discussed the needed transportation infrastructure investments for each of the three futures. This discussion revealed a core challenge, because investment in port and airport infrastructure was contingent on the future scenario. The Alien Nation scenario suffered from dramatically curtailed international trade. Thus, this future will need far less port and airport infrastructure. In fact, this scenario may mean lower overall economic activity and thus lower total freight volumes. Yet it seems unlikely that infrastructure developers can create the sensors in-the-ground that will give them the decades of warning they need to make appropriate investment decisions. At best, they might be able to detect shifts, which let them repurpose the assets. For example, seaports might be reused for intra-

costal shipping. The point is that it is hard to be nimble with 50-year assets. The uncertainty about the far future makes asset-based organizations averse to the large long-term capital investments needed to boost capacity.

The USDOT mentioned that one challenge with government funding is that the rising use of earmarks threatens the DOT's ability to make coordinated investments. SAFETEA-LU, a recent congressional transportation funding bill, included some 6,000 earmarks that left very little money for more general infrastructure investments. Both APL and the USDOT advocated the development of a national freight policy; without discretionary funds, however, the policy may not get implemented.

Participants complained about the rising use of tiered pricing for freight services in which carriers charge more for higher service levels. Whether it's billed as a special service, as congestion pricing, or as a surcharge for deadhead miles, some shippers felt it was price gouging. Shippers argued that they were being asked to pay even more for a service they had already paid for. Despite the grumbling, the MIT survey found that 32% of shippers have tried performance-based contracts and another 58% are thinking about introducing them.

The issue of money also raises the issue of better costing/pricing models. In some cases, pricing for transportation services, either private or public, does not properly reflect the true costs. This mismatch can go both ways. On one hand, the USDOT noted that trucks do not pay enough in fees to recoup the costs of wear and tear on public highways. On the other hand, the Port Authority of NY/NJ abandoned an intermodal barge project because the lift operator insisted on charging \$100 to \$150 for each of the four lifts required to move containers via barge to Albany. The point is that erroneous price structures distort the market and create system-level inefficiencies.

2.2.7. Research

The group discussed future research that could help tackle capacity problems. Many of these requests for research dealt with various elements of systems models for transportation. This research will help to further understand the network, cost, and management models. For example, the USDOT has collected a wealth of data in the form of the 2002 origin-destination dataset that the DOT uses to understand overall freight volumes on the highway system. Future DOT initiatives may even provide researchers and managers with up-to-date information using transducers and GPS on trucks. Understanding the complete network will help identify chokepoints, help prioritize investments, and improve routings.

Participants listed numerous areas for research. For example, research into regional networks could help the government better define and manage crucial segments of the infrastructure. Another research area cited was research into cost models and the effects of costs on transportation decisions, especially the effects of fuel prices. More targeted research might examine specific modes. For example, research could uncover how to make intermodal work on distances of less than 750 miles.

A related element of these system models is research on the theoretical capacity of the infrastructure -- trying to understand how far key elements of the network can be pushed. For example, CSX is adding more tons per car and more cars per train, but the system

still faces choke-points that drive the need to spend real money to put more rail on the ground.

Ultimately, the goal is to understand the confluence of effects of freight volumes, shipper strategies, carrier behavior, and infrastructure improvement on the performance of transportation systems. A detailed model of the U.S freight network would let researchers, shippers, carriers, and government officials understand what happens when, for example, an 8,000 TEU ship arrives at a port and the subsequent ripple of freight spreads across the country.

2.3. Solutions

The group discussed numerous general and specific solutions for boosting capacity. These solutions varied across time horizons.

2.3.1. Short-Term Solutions

Smoothing Flow Volumes

Smoothing the various daily, weekly, monthly, quarterly, and yearly peaks in freight volumes would help reduce congestion. For example, the Port Authority of NY/NJ sees better vessel scheduling as a low-cost, short-term solution for boosting effective berth capacity. One audience member joked that we need a major holiday in March to help smooth demand. Yet companies can take actions to reduce the problem. For example, some carriers are working to stagger sailing dates to avoid simultaneous arrival of too many ships at the West Coast. Another company helped reduce its quarterly “hockeystick” in shipments by changing sales force incentives and staggering the quota periods. Nearly three-quarters (74%) of shippers surveyed by MIT have tried or were thinking of trying shipping during off-peak times. APL highlighted the collaborative PierPass program in LA/LB that uses a peak-hour surcharge on local cargo movements to help drive the use of more off-peak movement.

Routing Asian Goods to East Coast Ports

The MIT survey found that half of all shippers have tried routing freight to other ports. The Port Authority of NY/NJ described the growing flow of traffic through the Panama Canal to help bypass congested West-Coast ports and to serve the populous East Coast directly. Yet this is only a short-term solution as the Panama Canal saturates and East Coast ports hit own limits. One long-term solution, described below, would include expanding the Panama Canal. The Suez Canal could also handle far more traffic and larger ships, but the route is less useful for China-U.S. freight flows. The Suez provides a more expensive route from China, but it is used for growing trade with India and South Asia. APL noted that a large fraction of its Singapore traffic uses the Suez.

2.3.2. Mid-Term Solutions

Increasing Asset Utilization

Recent problems with congestion and capacity shortages don't mean that asset utilization is at 100%. The presence of acres of empty containers in freight yards and the problem

of deadhead miles proves that asset utilization isn't as high as it could be. Companies continue to work to increase utilization to help increase capacity. For example, the Port Authority of NY/NJ is working to increase terminal capacity by reducing empties, improving chassis management, and reducing dwell-time. These projects are low cost, but it takes time to implement the new processes between the carriers, terminal, shipper, trucker, and the Port Authority.

Increasing Velocity

Asset utilization only tells a part of the story -- just because a container or truck is loaded doesn't mean it's getting the job done. Freight velocity is a critical metric for improving the true capacity of the transportation network. The faster the freight moves and the sooner it's unloaded, the sooner the transportation asset can be reused for the next load. Low velocities force the need for more infrastructure to handle the same amount of volume.

Although each mode of transport has some upper limit on velocity, most freight moves at less than maximum velocity. For example, APL showed data on rail freight velocity: high-priority intermodal freight moves about 24 to 30 mph, and low-priority freight moves an average of 20 to 22 mph. Worse, these velocities have been declining, which suggests the potential for a vicious circle in which congestion begets slowing which begets more freight stuck in transit, which creates more congestion. Already, transit delays of 2-3 days occur even in slack times, and boxcars often spend 70% to 75% of the time waiting in the terminal.

One opportunity, advocated by LXP, lies in timely operations at the loading dock: fast loading, hookups, and unloading. Another opportunity is in scheduling. Carriers complained that grocery stores are notorious for tardy handling of deliveries, which delays the trucks. Yet the stores complain that they often don't know when the deliveries will occur and thus can't schedule labor for unloading. Better advance notice and delivery windows would help both sides accelerate unloading. APL recommended that shippers provide improved demand forecasts to carriers. Better real-time data on congestion could help carriers make accurate predictions of arrival times.

Internal Process Improvements

Toyota is a strong proponent of correcting internal company processes that might sub-optimize or waste transportation resources. Toyota is now including transportation issues in the design phase of new car development. It ensures, if possible, that car components are as easily transportable as possible. For example, if a part can be shortened slightly in a way that improves cubing of a trailer, then Toyota will consider that design change. More generally, LXP suggested that shippers improve product handling requirements and dock operations to speed the loading and unloading process.

Yet internal process improvements take time. Others commented on the long-running problem of silos -- that the person who owns the inventory or has a sales quota often has no incentive to manage transportation costs. Decisions that minimize one department's costs often increase another department's costs such that total costs increase.

Labor Productivity

One cause of both embarrassment and hope is the low productivity of US ports relative to their foreign counterparts. APL reported that Asian ports such as Hong Kong have as much as twice the crane operator productivity of US ports like LA/LB. Yard operations are also much more efficient in foreign ports such as Hamburg and Asian ports. On one hand, these differences represent shameful under-use of technology and best practices for U.S. port operations. On the other hand, it suggests a radical opportunity for capacity improvement if the U.S. ports can re-negotiate archaic work rules. Estimates suggest that the port of LA/LB could handle as much as three times its current volume.

Several participants also called for better work rules as part of much-needed process improvements. The point is that moving away from non-collaborative entrenched positions on both the management and labor side of the table to reinvent freight handling practices for the benefits of both parties. A more collaborative management-labor relationship would also forestall a much-feared repeat of the 2004 West Coast Port Lockout.

Bigger trucks with more axles or combination trucks with two or three trailers would help cope with the driver shortages and HOS-mandated reductions in driver productivity. Yet many participants thought that bigger trucks will never achieve regulatory approval due to overwhelming opposition by the public. Even if an added axle ensures safe braking power, public fear of bigger trucks would overrule objective safety analyses. Moreover, heavier trucks would further degrade crumbling highways -- fees for these trucks would cover less than half the expected cost of the damage they would cause to highways.

2.3.3. Long-Term Solutions

Rebalancing of Offshore vs. Onshore Production

In the long-term, the costs and reliability of long distance freight transportation will affect sourcing strategy. One recurring question was whether transportation issues such as port capacity constraints, driver shortages, and high fuel costs might drive companies toward domestic or more local sourcing. Long supply chains add cost and create vulnerabilities to congestion. Yet, to date, there seems to be limited evidence of this. The MIT survey and audience feedback suggests that only a few companies have moved production back on-shore due to congestion or fuel costs. Only the car companies, such as Toyota, seem to be increasing domestic content. Some audience members did comment that companies might be less likely to move more production offshore in the current environment of high energy costs.

Other participants suggested that domestic sourcing does not solve core freight capacity problems because it doesn't eliminate freight. In fact, domestic freight volumes dwarf international ones. Instead of shipping from China through LA/LB, a company would still have freight from the domestic supplier, possibly from Canada or Mexico. Although domestic sourcing might alleviate pressure and congestion at the seaports, it still places a burden on domestic rail and road networks.

Intermodal Connections

Government and carrier respondents in MIT's survey recommended more intermodal and railyard infrastructure in their list of top-five priorities. The USDOT noted increasing deterioration at intermodal connectors. Too often, these last-mile roads between public highways and private transportation hubs get short shrift in funding. Intermodal connectors fall in the gap between public and private development. Government seems reluctant to fund the projects that don't provide obvious benefits to car drivers and but do seem to help for-profit companies.

One promising example of intermodal freight is on-dock rail: dropping shipping containers directly onto railcars without any intermediate drayage or terminal yard stowage. This can boost the terminal's productivity per acre by 50%, according to the Port Authority of NY/NJ. The technique does require new infrastructure with rail extensions alongside berths. CSX also cautioned that the technique only works if the containers are sequenced to avoid subsequent resorting. APL said that it is doing more of this, loading ships so that they can be effectively unloaded onto unit trains.

New Improved Infrastructure

Solutions to more effectively using existing capacity only provide a limited opportunity for improvement. Sooner or later, public and private entities will need to invest in added infrastructure. Yet these large projects take time, due to multi-year construction efforts compounded by multiyear planning and approvals processes. Moreover, the projects exacerbate congestion before relieving it -- construction often adds delays or narrows capacity while the new infrastructure is added to the old.

Panamanian voters are expected to approve this year's referendum for funding an expansion of the Panama Canal. The proposed \$5 billion project would allow larger ships and larger numbers of ships to transit the isthmus. Yet this project may take until 2014 or 2020 to complete.

The Port Authority of NY/NJ faces some unusual limits to its capacity that drive the need for expensive, long-term projects. Channel depth limits the free navigation and berthing of large container ships. The Port Authority has a long-running dredging program to increase the depths of key channels. Private port operators are also creating deeper berths. Another special capacity limit for NY/NJ is air-draft limits due to bridges. These bridges prevent the largest container ships from reach the port. The Port Authority has plans for a 10-year, \$600 million project to raise the bridge.

APL argued that added investment for rail is a top priority, second only to added investments in ports. The needed investments include investments in track, locomotives, and rail facilities. Railroads are making some of these investments now that prices have risen enough to ensure that rail earns a sufficient return on capital. CSX, for example, is investing in double-tracking in congested segments of its network.

2.4. Conclusion

Overall, symposium participants embraced a holistic view of the freight capacity crisis. Better collaboration, better visibility, and sharing of costs and benefits were cited as the keys to solving the crisis. Yet the challenge remains, because so many of the proposed

solutions will take years to implement and the 2006 holiday shipping season is fast approaching. Better collaborative management of existing assets and improved processes can help handle the expected growth in freight volumes. Quoting Benjamin Franklin, one speaker said, "We must hang together, gentleman, else we shall most assuredly hang separately."

3. Presentation Summaries

3.1. *Setting the Stage*

Dr. Chris Caplice, MIT Center for Transportation & Logistics

Dr. Caplice began the symposium by sharing the results of the 2005 MIT Transportation Infrastructure and Capacity Survey that was completed by over 500 shippers, carriers, and government agencies on a number of topics. One of the goals of the survey was to ascertain the amount of agreement among shippers, carriers and the government on important issues. For example, the first question asked each group to rank the root causes of the current congestion crisis in the transportation industry. Shippers and carriers were in fairly good agreement on the top five issues, but among government respondents factors like the driver shortage did not even make the top ten. The pattern of responses suggests that shippers and carriers focus on operational issues such as the growth of international imports and West Coast port congestion, whereas the government focuses on long-term issues such as the lack of funding and investment in freight infrastructure.

In response to a question about the impact of the congestion crisis on business, 80% of respondents said that their freight bill had increased in the past year and that transit time also increased, but interestingly, levels of safety stock did not increase substantially.

When asked what actions shippers were taking in response to the crisis, shippers said that they were having more meetings with carriers. The meetings focused on topics like establishing contingency plans to avoid supply chain disruptions, requesting solution proposals from carriers, collaborating with carriers on transportation forecasts, and requesting extensions of existing contracts from carriers. In short, the top actions that shippers were taking focused on more collaboration with carriers. In terms of what actions shippers are considering in the future, the top actions cited were: introducing real options into carrier contracts, shifting shipping patterns to off-peak times, and flexible contracting. Carriers' and governments' view of the actions which shippers were taking were basically aligned; there was a slight mismatch, but it was not substantial.

In terms of communication and interaction with government, however, responses showed that there was an overwhelming lack of interaction with government at all levels. Fully 63% of shippers never met with the federal DOT, and 66% never met with their state DOT. Even interaction with industry coalitions or lobby groups was sparse.

When asked to rank priority of new infrastructure projects, shippers gave top priority to improving existing highways, building new highways, and expanding existing terminals at sea ports. Carriers' priority rankings were similar to shippers', although the carriers gave second priority to expanding railroad track to include double tracking, and they ranked the building of new highways as only #7 in priority. Government respondents, like their shipper and carrier counterparts, ranked the improvement of existing highways as #1 and, like carriers, ranked double-tracking of railroad track as #2. The #5 priority for government was the creation of new logistics parks or hubs, which was #6 and #7 for shippers and carriers, respectively. Europe has been investing in logistics parks more than the US.

Finally, when it came to identifying entities to pay for the infrastructure improvements, shippers, carriers and government alike were in agreement that government should pay for any highway-related improvements, but all the other non-highway projects should be funded through a mix of private and public funding. Thus, the private sector was not expecting government to shoulder the burden of infrastructure improvements.

3.2. National Freight Transportation Infrastructure

John Bowe, President America Region, APL Limited

Mr. Bowe provided an overview on the nation's infrastructure system. The number of imports, as measured by TEU lifts, has risen from under 50 million to over 400 million in the past 26 years, and the rate of growth is increasingly sharply. Since the year 2000, for example, the number of imports has doubled. Imports from China have been the primary driver of this increase. In the near future, the number of imports will continue to grow. A survey of 800 North American manufacturers by Deloitte shows that 55% of manufacturers plan to enter or expand their sourcing in China. At the same time, current road, air and rail transportation systems are having trouble keeping up with the demands of these longer supply chains. Companies need to be more aware of the shortcomings of the current infrastructure in order to fully value the costs and consider the effects of delays in the supply chain. Moreover, the private sector will need to play a greater role in addressing the problems, because government alone does not have the funds to solve the problem. Consumers have not yet felt the impact of the strained infrastructure, which explains the delay in action taken to address the problem.

The passage of SAFETEA-LU ("Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users") authorizes \$286.4 billion for highways and transit for FY 2005 to 2009, but it will have a nominal impact on intermodal infrastructure, and the DOT was left with no discretionary spending. The problem is that "freight does not vote" -- people vote, but so far, shippers have not banded together to show the strength of the infrastructure need.

APL is a Singaporean-owned company (there are no US-owned ocean vessel companies), but APL has been working with the World Shipping Council and the DOT, among others, to bring together a group of shippers large enough to attract the US government's notice and focus attention on intermodal issues. The group -- now with 10 shippers such as P&G, Limited Brands, Dell and Target -- represents \$343 billion in total sales and over 1.5 million employees. The group advocates a National Freight Policy and a focus on improving port productivity as well as intermodal infrastructure and rail performance.

Freight Tsunami

The volume of freight is reaching tsunami proportions. Major ports in the US saw double-digit growth from 2004 to 2005, and the volume of freight is rising faster than productivity. The Journal of Commerce projects some moderation of the growth rates as the economy slows, but the total trans-Pacific volume will continue to increase.

Port Productivity

The US West Coast ports, particularly the port of Los Angeles/Long Beach, are the gateway ports from Asia. During the worst of the congestion problems in 2004, carriers diverted vessels from LA/LB to other ports. The vessels have now returned again, however, as alternate gateways became tight. APL commissioned a study of the capacity issues of the Panama Canal and found that the canal will reach its maximum effective capacity in about 2-3 years if no expansion takes place. There will be a referendum in Panama that would authorize the government to float bonds for a \$5-6 billion modernization of the canal. This is not a near-term solution, but it is encouraging to see that some expansion or modernization plans are being considered.

The port of LA/LB is the busiest container port in the US. In mid-2004, it reached 277 vessel calls per month. Insufficient labor at the port caused delays that resulted in a backup of the system -- a precursor of delays that may come again as volume increases. For about 2-3 weeks in mid-2004, ships backed up, and it took until the end of the year for flows to begin moving smoothly again. One reason for the restored flow was that the number of vessel calls decreased from 277 to 215 in early 2005. The number of vessel calls is now increasing again, however, because capacity at alternate ports has also become tight.

As a nation, the US shouldn't be satisfied with its busiest ports being only half as productive as the world standard. Annual container berth productivity at the port of Hong Kong, for example, is 700,000 TEUs per berth per year, compared to only 350,000 for LA/LB. The US is a leader in productivity in many areas, but it lags far behind in port productivity.

Ways to improve productivity include public/private partnerships -- indeed, even private/private partnerships -- that shift some capacity out of peak times to a night shift. For example, PierPass is a public/private cooperation between marine terminal operators and the shipper community in LA/LB. To alleviate some of the traffic congestion problems at ports, shippers agreed to a \$50/TEU fee imposed on local cargo moving via trucks during peak hours. The extra fee is used to fund movement in off-peak hours. Shippers saw the fee as a way to get fluid movement, and initial results show that over 30% of total truck traffic moved off-peak. This move reduced port-related truck congestion at peak times and had a positive impact on turnaround times as well as on the environment. Shippers were willing to pay the extra fee because they knew it would be used within the system to improve it, and that is indeed what happened.

Rail Performance

Rail performance needs to improve in order to alleviate pressure on the rail infrastructure. The American Association of Railroads shows that railroad velocity is decreasing. If velocity slows, then more investment is needed to move the same amount of freight, and any investments to improve speed get consumed. APL sees investment in rail as one of the biggest opportunities to improve freight capacity in the US. Improvements in inland terminals will ease the bunching and surging of cargo and will have the biggest impact on improving overall speed. APL is looking to stimulate investments in rail and intermodal capability. Without such investments, customers will see longer transit times that will increase supply chain costs.

What Shippers Can Do

In an environment in which trade volumes are increasing, the infrastructure is stretched and supply chain lead times are being extended, there's a higher premium on cooperation. Shippers who communicate and cooperate more closely with carriers -- such as on joint planning and commitments to which both sides adhere -- will benefit. Shippers can give carriers improved demand forecasts or consider entering into multi-year relationships. They can also look for opportunities to distribute flow volumes more evenly through the year, although this is not a feasible option for many. Shippers can also join with transportation industry partners to focus government attention on infrastructure development and to support efforts to improve the labor situation at West Coast ports.

What Carriers Can Do

Carriers need to be more nimble throughout the year and work with shippers to move volume off-peak whenever possible. Carriers, like shippers, can also work to improve the relationship between industry and labor on the West Coast. Some of the actions which APL has taken to increase terminal capacity has been to introduce RFID and optical character recognition at gates to reduce costs while improving accuracy and productivity. Current work rules make it cost-prohibitive for West Coast ports to operate 24 hours a day like ports in Asia. Security practices, however, have not reduced productivity.

The major gains in productivity will come through changes in work rules, and these changes are even more important given that West Coast ports have limited ability to expand physically, because there is not enough land onto which to expand. Global trade continues to grow, but US infrastructure and productivity is not growing nearly as fast. By working together, shippers and carriers can help influence a national freight policy and improve productivity in port and rail performance.

3.3. Local Government Perspective: Infrastructure Initiatives at the Port of NY/NJ

Peter Zantal, Port of NY/NJ

As its name suggests, the Port Authority of New York and New Jersey operates in two states under the leadership of the governors of the two states, along with a Board of Commissioners chosen by the governors. The Port Authority (PA) was established in 1921 by an act of Congress and is financially self-supporting through user fees and bond issues. The PA is responsible for airports, tunnels, bridges, commuter lines, ports and the World Trade Center site.

In 2002, world trade contributed 20% of the US GDP, and it is expected to contribute 30% by 2012. Import growth since 1995 has been growing relative to GDP, and in 2004 (the last year for which figures are available), import growth was double that of GDP growth.

The Northeast is the largest market in the US; the states of New York, New Jersey and Connecticut represent 12% of the disposable income of the US. Asia has been driving the growth of imports. Higher trade volumes are forcing carriers to look to larger vessels,

which puts further strain on existing infrastructure. For example, larger vessels may be too tall to clear bridges or run too deep for shallower harbors.

The Port Authority's mandate is to operate in an environmentally and financially sustainable manner, providing a return to the Port Authority and the region. Indeed, the PA has generated about 237,000 jobs in the region, in the form of truck drivers, warehouse workers, and even lawyers for international trade issues.

Given its mandate, the Port Authority has to provide sufficient capacity for the port to grow and the region to prosper. But, capacity is becoming a big challenge. Capacity is a systems issues -- all of the components of the system must be sized properly in order for capacity to actually be improved. Thus, capacity must be seen from a regional or corridor perspective.

The three key components of capacity that must be addressed are: channel capacity, terminal capacity and access/egress capacity. One solution to improving channel capacity, for example, is to create deeper channels and berths. The PA is undertaking the largest dredging project in the US, receiving \$110 million from the government (which is paying 65% of the cost of dredging to the depth of 45 feet, and 35% of the cost beyond 45 feet, with the Port Authority funding the rest through user fees). The project is a medium-to-long-term project, taking about 10 years from start to finish. The PA, terminal operators and the US Army Corps of Engineers are working together on this project. All of the dredged material is being processed and used. For example, rocks are used to create artificial reefs, and sediment is mixed with cement on brownfields such the surface of the parking lot for the Garden State Mall. New Jersey built a golf course with reprocessed dredge material.

The PA is also looking at air draft capacity. For example, the Bayonne Bridge is at a height of 151 feet (from high tide to the bottom of the bridge). The larger vessels of today are too high to pass under this bridge. The PA examined three approaches to solving the height problem: 1) rebuilding the roadway at a higher level, 2) raising the entire bridge and 3) building a new bridge. The cost of these projects would be about \$600 million and would take ten years to complete. The completion time depends most heavily on the time required to get environmental permits -- the time spent on the actual building of the project is the shortest.

In addition to exploring infrastructure-based solutions to the air draft problem, the PA examined alternative solutions. The PA sent a questionnaire to 30 major owners of vessels, such as APL, looking at modifications which could be made to ships rather than to the bridge. Analysis showed that a 6000 TEU ship could be modified at a cost of \$261,000 to fit under the existing bridge. Making these modifications to follow-on ships would cost about \$200,000 per ship. So, \$600 million could be spent on the infrastructure project, or ship owners could spend about \$9-10 million each to modify a string of nine vessels, which could be amortized over 1-2 round-trips per vessel.

Terminal capacity is constrained by berth capacity, container yard capacity, and gate capacity. Productivity goes a long way toward improving physical capacity. For example, berth capacity can be improved through better scheduling of vessels.

The US could make great strides in productivity improvements. The productivity of ports like LA/Long Beach is only half that of Hamburg. The productivity of Singapore's port is so high in comparison to US ports that the PA didn't even include it on its chart, because it would skew the chart so much. Training and technology could improve productivity. In the port of NY/NJ, the average crane operator has only been on the job for 2-3 years. A new training facility with simulated cranes will help train operators to get the most productivity out of the cranes.

In container yards, RFID, trace-and-track and new machines will help improve productivity in the near- and medium-term. Other solutions include smarter operations, such as reducing the number of empty containers. Fully 40% of containers in NY/NJ are empty. Getting those empties out of the port area would ease congestion. Such solutions are not that expensive to implement, but they require changing habits and practices.

Gate capacity can be improved through extended hours of operation, automation and more terminals. The port of NY/NJ has recently installed a new gate system that can scan empty containers electronically rather than requiring them to be physically opened.

The current infrastructure in the US is insufficient to meet current demands, so the problem will only get worse as trade increases further. Capacity-enhancing projects, however, are complex and require funding from various sources. For example, funding of gateway corridors requires intra- and inter-regional cooperation. Existing federal and state funds cannot keep pace with demand. User fees are one solution to filling the gap. A study by the Southern California Association of Governments showed that user fees of up to \$200-400 per lift unit would be acceptable if they improved speed. Beyond that, ports risk diverting trade away from the port.

3.4. User Perspective: Tactical Solutions!

Moderator: Gary Girotti, VP Transportation – Chainalytics

Panel: Paul Newbourne – LXP,

Dale Lewis – CSX,

Bill Thompson – Masterfoods USA

Mr. Girotti led the panel in a number of questions concerning how shippers can combat the current capacity crisis. He first asked what each panelist learned from the Capacity Problem of 2004 and 2005.

* Paul Newbourne – LXP: Supply chains are getting longer, which has downstream implications inland. There is also a growing level of expectations for faster, better and cheaper service. The strong economy is good for all of us but it brings strong demand for products. Regulations, such as Hours of Service, have changed twice in the last 24 months and have further aggravated the capacity situation. The increasing cost of fuel may impact smaller carriers. Companies are being more selective about whom they put behind the wheel, but being a truck driver is still not an attractive career, which further presses capacity. Carriers are being more disciplined in their investments. If a fleet is not highly productive, carriers won't invest more in it, so the net fleet size isn't growing. Indeed, carriers are downsizing their fleets.

* Dale Lewis – CSX: The railroad industry spent the last 25 year shrinking, so now when it sees increased demand for capacity, that increased demand is difficult to believe. The industry is not sure it should invest in new capacity, because those investments will require a long time to recoup. CSX is seeing an increased willingness from shippers to agree to rates that will let CSX invest in new railroad cars. Three years ago, 60% of CSX's car types did not justify a rebuild – the investment had a negative margin contribution. So railroads are faced with assessing if the demand for additional capacity is real and is strong enough to justify new investments.

* Bill Thompson – Masterfoods: There are things companies can do internally to find capacity, like improving our relationships with carriers, having carrier-friendly freight, giving advance notification, shipping fewer trucks, having better truck weights -- all of these help asset utilization. Masterfoods wants to be the preferred shipper and do everything we can, but sometimes our own customers can create a bottleneck. It's hard to send a truck to a customer who takes 12 hours to unload it, so you have to make the sales folks aware of that. Some customers may not be served.

* Schwann's: We're a shipper, and during the first seven months of the year, we have no problem with capacity or expense. In the fourth quarter, however, we have to pay for lots of deadhead miles, even if it's just 20 miles from where we need it, we have to pay for 400 miles, so that's a huge expense.

* Chris Caplice: Carriers are getting smarter -- they're not chasing every piece of business anymore. They're picking and choosing.

* General Mills: Our demand is tied to seasonality, but it's also tied to merchandising. We're trying to even out demand better. We have a dedicated fleet of 400 trucks, but we could support 1000 trucks during the last six months of the year. But they'd be idle during the first six months. So we're working with our sales organization to manage their trade calendar better so that we aren't so dependent on the last months of the year.

* Paul Newbourne – LXP: The problem is not just fourth quarter, but the end of the month, due to artificially-induced sales incentives. And now with Sarbanes-Oxley, you have to ship in that quarter. This is an internal behavior that we need to work on.

* Bill Thompson – Masterfoods: If oil prices hit \$100 or \$120 dollars a barrel, we may need to do network modeling again. Our networks may no longer be right for high fuel prices. Perhaps we need more warehouses or factories -- building these may be worth it to reduce freight costs.

When Paul Newbourne was at Conagra, the company studied the costs of its end-of-quarter freight, measuring any premium transportation costs incurred. It then used those figures with the sales organization, to change their behavior. Rather than incentivizing the entire sales organization to meet certain sales levels by the end of the quarter, Conagra spread the incentive program over the month and over the quarter. It took two years to gain acceptance with the sales organization, but the cost of premium transportation was a powerful argument because the salespeople had to justify why the extra dollars were worth it.

CSX has used optimization modeling, but lack of internal communication causes spikes and dwell time, which cost the company over \$1 million per year. The problem is that

the numbers are "someone else's numbers." The costs cause service delays, however, so they do impact the whole company and the shippers.

For companies like P&G, sales of consumer packaged goods are tied to external forces: consumers get paid at the end of the month, so P&G sees that the bulk of its sales come the first week of each month. For Masterfoods, Halloween accounts for a majority of its sales. The date of the holiday is known in advance, of course, but gaining freight capacity at the same time that manufacturers are shipping for the Christmas season is difficult. Not surprisingly, Masterfoods cannot ask its retailers to stockpile candy ahead of Halloween. The problem is that so many shipments peak at the same time. Planning ahead can also be hard given retailer practices. Wal-Mart sends a forecast each Monday at noon for shipments it wants to receive by Friday. Manufacturers can estimate how much they will need to ship, but they cannot plan the exact shipment until they receive the order from Wal-Mart on Monday.

Shippers and carriers alike are looking for ways to deal with the driver shortage. One approach is the use of driver incentive programs. The difficulty is in identifying the proper incentives. For example, the idea of paying drivers a bonus if they get the load delivered on time seems to reward on-time performance and satisfy customers, but the question is how to balance safety and factors that are beyond the driver's control. On-time incentives could encourage drivers to speed or be more reckless; Domino's withdrew its 30-minute pizza-delivery guarantee after a driver accidentally killed a person in a rush to deliver the pizza on time. Other factors, like congestion, are beyond the driver's control. A driver delivering in Boston traffic feels only frustration as his bonus evaporates when he's stuck in traffic.

Moreover, a deeper problem exists: the industry is not attracting new drivers. Increases in pay seem to simply be enticing turnover among existing drivers rather than encouraging new ones to enter the field. As one participant quipped, "How many of you are encouraging your children to become truck drivers?"

Managing dedicated fleets is often more burdensome for shippers, but shippers are turning to that option in order to have the assurance of having assets when they need them. Having a dedicated fleet requires a critical mass of shipments. Shippers still lack capacity during peak times, however, because they cannot justify the size of fleet needed to handle peak times.

Carriers don't like bidding situations, but shippers periodically use bids to level-set the market. Some shippers exempt key incumbent carriers from the bid if the carriers are providing value and delivering well. Bids may be asked from new carriers or carriers whose performance is lacking, such as in accuracy of invoices or not accepting all tenders. Shippers often have a mix of strategic-partner carriers and transaction-based relationships. Shippers will also bid out on lanes whose prices seem out of balance. Sometimes, the simple act of communication between shippers and carriers solves the problem. Delays or higher prices in a lane may be shipper-caused. Finally, reevaluating networks every two years makes sense, because both shippers' and carriers' networks change. The purpose of the bid is not just to get lower pricing, but to optimize the network overall. In a large network, it may be impossible to collaboratively discuss

which lanes are most profitable to which carriers, so a bid can be a strategic tool to match carriers with their most profitable lanes. One carrier's trash lane could be another's pearl.

The railroad industry will see a big change in the coming five years, as 70% of its workforce turns 60 and retires. Over the next five years, all the executives who worked in the railroad industry when it was a regulated market will have retired. Among conductors, 8500 freight car conductors will be retiring. The new hires will be required to have a tablet PC and have accountability like UPS drivers do. Moreover, the railroad's need to hire 10,000 new workers may put an even bigger squeeze on trucking, as the railroads will be offering \$60,000-\$80,000 annual pay.

3.5. *Wrap up and Overview Discussion*

The first day concluded with a group discussion on what were the takeaways and topics for additional research. The following bid takeaways were noted:

- The need for collaboration between public and private enterprise. The government could consider looking at somewhat shorter time horizons, while shippers could look at slightly longer horizons. The National Freight Policy was looking for input 20 years into the future, but shippers typically look only 5 years ahead.
- To ease capacity problems, shippers may want to review their own networks and evaluate trade-offs, such as between transportation and inventory, or the location of their DCs.
- The next 10% of additional truck capacity will be much more expensive and unstable -- there might be a rationalization of modes.
- The issue of who will pay for capacity growth remains. Funding won't come entirely from the government or entirely from the private sector. Some creative solutions, such as a private company from Spain buying a public tollway in Chicago, are possible. Or, the use of government bonds or loan guarantees to support private infrastructure development.
- Carriers are getting smarter about pricing and are being more disciplined, not chasing every load but analyzing them to decide which ones will be profitable for them.
- High oil prices may force companies to change their networks, such as pushing DCs closer to the consumer, choosing less expensive modes such as rail, or doing more domestic sourcing.
- Shippers can find additional capacity by improving existing processes, such as by using off-peak hours, weekends, midweek shipments in ports, or working with suppliers or other shippers to pool loads or reduce deadhead miles.

The most critical research topics identified were as follows:

- How to define a region for the purpose of regional planning to identify a corridor, for example.

- How should firms measure and quantify the financial and structural impact of rising energy costs.
- How can more collaboration between government and shippers be facilitated in order to optimize the network (optimizing one area might create a ripple effect; deciding which area to invest in for the most impact)
- Studies of the network, such as the origin/destination map which Tony Furst showed. Shippers (such as Staples) do a 5-year business plan, and such data and maps may help them cluster themselves efficiently with other shippers. (Logistics parks may be one solution.)
- The real capacity of ports. For example, what would be the capacity of the port of LA/LB if they ran a third shift? What if rail capacity goes up in a given corridor? What are the chokeholds? (The port of LA/LB is likely operating at only 1/3 capacity compared to how much many TEUs could be processed under different work rules.)

3.6. Federal Perspective: Framework for a National Freight Policy

Mr. Tony Furst, US FHWA

Given the diversity of organizations -- both public and private -- who have a stake in freight policy issues, communication is critical. Communication needs to take place within the transportation sector, so that public partners understand supply chain logistics and that private partners understand the role and capabilities of the public sector. Communication beyond the transportation sector is important, too, so that elected officials and the public at large understand the problems and benefits of freight transportation.

As one way to facilitate private-public dialogue, the Transportation Research Board (TRB) created the TRB Freight Industry Roundtable. The Roundtable's charge is to improve the US Department of Transportation's (DOT) understanding of supply chain logistics and, in turn, to improve industry's understanding of the USDOT's role and capabilities. The roundtable has been meeting since mid-2005 and has one final meeting scheduled for the end of May 2006.

The National Freight Policy Framework provides not only a vision and objectives, but also strategies and tactics down to the level of responsibilities and tasks, to outline who can do what to achieve the objectives.

The vision statement of the framework is: "The United States freight transportation system will ensure the efficient, reliable, safe and secure movement of goods and support the nation's economic growth while improving environmental quality." The framework has seven objectives (not listed in priority order):

- Objective 1. Improve the operations of the existing freight transportation system.
- Objective 2. Add physical capacity to the freight transportation system in places where investment makes economic sense.

- Objective 3. Use pricing to better align all costs and benefits between users and owners of the freight system and to encourage deployment of productivity-enhancing technologies.
- Objective 4. Reduce or remove statutory, regulatory, and institutional barriers to improved freight transportation performance.
- Objective 5. Proactively identify and address emerging transportation needs.
- Objective 6. Maximize the safety and security of the freight transportation system.
- Objective 7. Mitigate and better manage the environmental, health, energy, and community impacts of freight transportation.

An example down to the level of tasks and responsibilities follows:

- Objective 5. Proactively identify and address emerging transportation needs.
 - Strategy 5.3. Develop data, analytical and professional capacity for making future investment decisions.
 - Tactic 5.3.5. Endorse/Establish Freight Advisory Board for Public Agencies
 - Task: Engaging the Private Sector Workshop
 - Responsibility: Federal and Local
 - Task: Establish Freight Agency Advisory Committees at appropriate level
 - Responsibility: Federal, Local and Private

Mr. Furst explained how the objectives can be achieved in multiple ways. For example, for Objective #1, transponders that can communicate with the infrastructure can be installed into vehicles. The DOT can instrument the infrastructure to better manage traffic and speeds in real-time. The timing of signals, for example, can be adjusted in real time to improve traffic flow.

In addition to technological aids, changes in practices can improve congestion. For examples, the extended gate hours made possible with PierPass have helped to reduce peak-hour congestion. One major cause of congestion and slowdowns is traffic accidents. Clearing accidents quickly is important. Maintenance zones on highways are the second biggest cause of delay, after accidents. The majority of highway funds goes toward simply maintaining the roads, however, not increasing capacity.

Objective #2 focuses on adding physical capacity. The question is where and how to fund it. Multi-state coalitions that take a regional approach are likely the best approach because simply improving one piece of a highway won't solve the congestion problem. The question is how to define a region and how to put the coalition together. Coalitions with their strength of influence can focus DOT attention on the national importance of addressing these capacity problems and target funding to high-priority regions.

In a step toward addressing Objective #3, the USDOT met with a working group to discuss how technology could improve the flow of international freight. The working group identified information flow as a big problem, especially across multi-carrier supply chains. All the parties do not have access to all of the same data. Limited Brands has taken an active role in helping here, allowing the group to model Limited Brands' supply chain from Hong Kong to Columbus, OH to act as a model of the supply chain. The working group will be developing a web services model that members can pull data from a common database to get the data they need.

Solutions to the capacity problem can take place at the national level as well as at local levels. At local levels, carriers can take the lead and talk with state DOTs. At regional levels, shippers can join together to address multi-state issues.

3.7. Future World Scenario Planning Exercise

Dr. Mahender Singh – SC2020 Project Manager, MIT-CTL

To illustrate the purpose of scenario planning, Dr. Singh began with a quote from Charles Darwin: “In the struggle for survival, the fittest win out at the expense of their rivals because they succeed in adapting themselves best to their environment.” The point is that those who survive are the fittest ones in terms of their environment, not necessary the strongest ones overall. Adapting to the environment is what's important, and scenario planning is a tool that can help companies adapt to the environment of the future.

Scenario planning is different from forecast planning, Dr. Singh explained. With forecast planning, planners are planning for one future, one view of the world. But what happens if there are many uncertainties? During forecast planning, planners try to exclude the uncertainties. They extrapolate from current knowns and then adjust the plan 10% upward or downward to formulate the intended strategy. But because conditions start to change almost as soon as the forecast is done, the strategy starts to diverge fairly quickly from the intended strategy.

Scenario planning, on the other hand, can help companies prepare for the future better because it helps them plan for any future, not just one future. Instead of trying to eliminate uncertainties, scenario planning helps planners be more aware of future uncertainties and to work with them rather than eliminating them. Dr. Singh offered the analogy of boxing vs. judo to compare forecast planning with scenario planning. Rather than simply trying to duck or avoid the impact of environmental forces (punches), scenario planning helps you leverage the forces to your own benefit.

Scenario planning involves creating multiple, internally-consistent stories of the world. Scenarios are tools for identifying strategic options in the face of uncertainty. They help decision-makers think productively about contingencies and alternatives, instead of getting paralyzed by uncertainty.

There are two levels of scenarios: descriptive and prescriptive. Descriptive scenarios are less detailed, and they focus on external forces. They emphasize key uncertainties and challenge prevailing mental models. Prescriptive scenarios tend to be very detailed and specific to a particular organization, with a focus on developing executable strategies. Given the diversity of the participants at the symposium, the scenario planning session at

the symposium focused on descriptive scenarios. The goal was to provide participants with a better understanding of the transportation industry by becoming aware of each other's constraints and mental models.

The Scenario Generation Process

The first step in the scenario generation process is to identify the fundamental question to be addressed. The question can be broad, such as “What is the future of supply chains?” or it can focus on a more narrowly-defined problem, such as congestion. The second step is to select a global scenario. Organizations like the CIA and Shell have invested in building rich global scenarios. Shell scenarios can be purchased from Amazon for \$25 and can be used as a starting point for scenario planning work. The third step is to create a filter through which the scenarios will be viewed, such as a logistics filter. Filters let you focus on the issues of most importance to your organization. The fourth step is to work with the scenarios and engage people in thinking about these future worlds.

The guiding principle for scenario generation is to make sure that uncertainties are included in the process, so that everyone is made aware of the key uncertainties. It is not necessary to predict events; rather, the purpose is to be prepared to respond to various events that might happen. For example, during their scenario planning process, UPS executives realized that their company would need to have a strong customer-facing presence. Existing UPS locations had an industrial feel, and the company realized it would need a more friendly, welcoming environment. With this awareness, UPS bought Mailboxes Etc. (MBE). FedEx, in response, bought Kinkos -- at a roughly ten times the price that UPS paid for MBE -- for less than half the number of locations.

Probable Future States

A key theme of Shell global scenarios is that two crises threaten the globalized world: a security crisis (based on the emergence of global terrorism) and a trust crisis (based on a series of financial scandals such as Enron and Worldcom). These dual crises will drive fundamental changes in the world.

According to the philosophy of Shell scenarios, three forces -- markets, governments and communities -- operate in the world. Each of these forces has its own objective. The main objective of markets is efficiency; the main objective of governments is security; the main objective of communities is social cohesion and justice. The world will evolve from the interaction of these three forces. Business leaders push for a market-centric dominating force, whereas governments struggle for a state-centric one and communities strive for a society-centric world. Typically, two of the players try to balance each other while the third plays a lesser role.

Dr. Singh and his colleagues conducted a thorough literature review of academic journals and trade publications to identify future logistics challenges. From those challenges, they identified key challenges to the underlying macro-factors, such as the geopolitical environment, trade and protectionism, the energy situation, and environmental constraints. Next, they rewrote the Shell scenarios to highlight logistics concerns. The result was three scenarios that represent three different end states: Alien Nation, Spin City and Synchronicity.

3.7.1. Description of the Three Scenarios

Scenario 1: Alien Nation

In the world of the Alien Nation scenario, citizens think and act locally, distrusting foreign peoples and governments. Globalization is restrained by nationalistic policies, and trade barriers are ubiquitous. Energy is a hot-button issue as countries compete for dwindling national resources. Lack of standardization across global trading and commercial systems makes international expansion risky and expensive. As a result, companies focus their endeavors on national markets and customers. The major threat to world stability is unsynchronized business cycles and investment strategies. Nationalistic attitudes also obstruct immigration, even though there is a high demand for younger migrant workers in many countries.

Scenario 2: Spin City

Trust and national security issues dominate political and corporate agendas. Globalization remains a powerful force, but it is hamstrung by a complex web of conflicting regulations. Governments' efforts to strengthen security result in greater government intervention and more complexity in trading markets because the ground rules for trade are in a constant state of flux. Trust is a distinct competitive advantage. To compete globally, companies have to build solid reputations for being trustworthy. The conflict at the heart of this world is: should regulation or market forces champion trust and physical security?

Scenario 3: Synchronicity

In this most positive view of the future, demographic ideas have taken hold across the globe, and intrinsic to these ideals is the notion that all parties -- whether they be individuals, companies or governments -- must trust each other. In this world, trust does not impede business or societal relationships -- it promotes them. As a result, untrammelled global commerce flourishes in Synchronicity world, to such an extent that a major challenge for companies is keeping up with constantly shifting market demands and technological breakthroughs. Qualities such as trustworthiness and integrity are essential to business success. Life is rich but frenetic, and people like to sample as much of it as they can. They change jobs frequently, which presents a challenge for companies that increasingly rely on "knowledge workers" to create the customized products and services which customer demand. Environmental protection has become a universal aspiration.

3.7.2. Scenario Implications

Symposium participants divided into three groups, with a mix of shippers, carriers and government representatives in each group. Each group worked with one of the scenarios in detail, to identify the implications of that scenario.

Implications of Scenario 1: Alien Nation

- Infrastructure: There is a need for increased capacity across all modes, as required by government and markets. Government will make investments in order to maintain control and security. There will be public/private

partnerships and a bigger role for land use planning, such as not building new communities next to an airport.

- **Technology and Processes:** Technology will provide more visibility to track goods and commerce around the world in real time, but there will be more regulatory use of the technology (to enforce governmental regulations).
- **Sourcing:** On one hand, security issues may shorten supply chains. On the other hand, the need to locate closer to the customer in order to deliver faster to them may lengthen the chain. Consortia may exist, in the form of qualified suppliers. There will be a lot of collaboration between shippers and carriers to establish more efficient operations. Carriers may use a hub-and-spoke organization to focus in a given area. Companies will focus on their core competencies and outsource the rest.
- **Organization:** There will be more consolidation of the industry, but new entrants will emerge on the fringes and could transform the industry as a whole. There will be increased use of 3PLs because of the need to outsource and because of the aging working population.
- **Regulations:** Governments will allow migrant workers to enter the country to take jobs like truck driving, but there will be extensive background checks. Trading caps, such as the steel quotas of a few years ago, will reemerge to protect US companies. Regulations will force companies to consider reverse logistics to bring back their waste products and make more environmental improvements.

Implications of Scenario 2: Spin City

- **Infrastructure:** The preponderance of investment goes to border control, scanning, and other infrastructure that makes people safer. The bias is toward domestic production, because nations do not want to trade extensively with the world. As a result, the infrastructure of importance is the land-side infrastructure: highways and railways rather than air.
- **Technology and Processes:** Investments are made in technology and processes that focus on tracking and tracing where things are and where they are going. There is also a focus on energy efficiency, because of the need for nations to be self-sustaining. Technology will also be important for automating work, because there will be no migration of workers. Finally, technology will provide visibility into the supply chain in order to drive efficiency.
- **Sourcing:** Companies will integrate vertically because of the concern about access to raw materials in the world of self-sufficiency. Recycling and energy conservation will be important due to the lack of raw materials. Long-term contracts and far more local product will be the norm.
- **Organization:** There will be far more regulation on a national scale as well as a regional scale. There will be more use of private fleets to secure resources.

Fuel efficiency will be important because of the need to be self-sufficient, and movement of people will be more important than movement of freight.

- Regulations: There will be higher tariffs, higher government regulation, and incentives not to bring foreign products into the country. There will be a large number of energy-efficiency and environmental standards and regulations, as well as a federal database on people who work in the transportation industry to ensure credibility in background checks.

Implications of Scenario 3: Synchronicity

- Infrastructure: There will be a need for more infrastructure to promote the flow of goods and people. There will be more private funding and less government funding. The social infrastructure includes a collective group of knowledge that is shared equally.
- Technology and Processes: Technology will provide end-to-end visibility and the free flow of knowledge. There will be automated conveyance for the optimal handling and flow of shipments and good data to support the automation.
- Sourcing: Inventory costs are critical, but the total cost-to-own is the key measure. Because the risks of global sourcing are low, the only costs of longer supply chains are inventory costs, carrying costs and reliability.
- Organization: Companies will be more global and more integrated. 5PLs -- integrated to twice the level of 4PLs -- will be much bigger and more integrated so that they can leverage freight and make movement of goods more environmentally friendly and efficient.
- Regulations: Trade regulations will be enabling -- there will be less government regulation, and it will get replaced by international standards such as ISO standards. There will be more cooperation on security and environment issues.

3.7.3. Discussion

The Synchronicity world felt utopian because government was out of the way. Shippers and carriers took on the longer-term view on their own. But the discussion didn't address who will pay for the schools or the transportation infrastructure in such a world. Will it be private infrastructure? There might be other shortcomings in this scenario, such as competition for workers. Whereas the other scenarios listed downsides, the synchronicity scenario did not list the downsides associated with that world.

The most useful ideas that companies can glean from this exercise is to look at the implications that came out of each of the scenarios and identify which ones fit into one of three categories: 1) no-brainers 2) no-regrets and 3) no-gainers. These three categories comprise the Robust Implications on which companies can take action. For example, if the same implication arose out of each of the three scenarios, then it is clearly an implication that should be implemented because it is robust under any future -- it is a "no-brainer." The second category, the "no-regrets" implications, are those implications that

make sense to implement in one or two of the scenarios and create no harm to implement in the third. The no-regrets category is like insurance: the idea is sound in most cases and costs comparatively little if it does not come to pass. The third category, “no-gainers,” are ideas that are currently on a company's agenda but that make no sense under any scenario. Implementing them brings no gain to the company. It is satisfying to identify these no-gainers and stop investing time and money in them.

In addition to these three Robust Implications, companies can identify a set of Contingent Implications. These are implications that are essential in one scenario but very painful in another. Companies should map these implications onto the scenario and create an early-warning system to look for any early indications that the given scenario is beginning. If that particular scenario is beginning, the company can start to implement that implication. Otherwise, the company should postpone implementing that idea. Probabilities will factor into this decision-making process -- companies will want to decide whether to make the big bet needed if that scenario comes into being.

No-Brainers included: Investment in technology for visibility, Consolidation of carriers, and Environmental regulations.

No-Regrets included:

- Investment in security is mandatory in Alien Nation and Spin City, and it is a no-regret under Synchronicity (just a cost of doing business).
- Lobbying the government is important in Alien Nation so that the government does not regulate against you, and it is important in Spin City so that you can influence the investment schemes. In synchronicity, it wouldn't be important, so companies would invest less in it.

Contingent Implications focused on finding a sufficient workforce. In Alien Nation, migration would not be allowed, so there would be a need to invest in automation. In synchronicity, there would be a battle for workers and a need to locate offices around the world. To know which world is coming, the sensors-on-the-ground to watch are immigration policy, demographics and the retirement age.

Participants found the scenario planning process to be engaging. The idea of thinking, "if this world were true, could we survive?" engaged people and let them test out their current strategy in new worlds to see how their strategy might play out in the different worlds.

The process put a structure on how to think about the future and let people look consciously at assumptions and constraints. P&G uses scenario planning for transportation sourcing. Masterfoods will use scenario planning for integrating new businesses, to identify no-brainers, no-regrets and no-gains as a way to think about the integration process. Scenario planning also teaches the importance of being able to live with uncertainty.