TRANSPORTATION FOR THE NEXT CENTURY pdf

1: Next Future Transportation

However, in the 21st century, transportation's focus will shift to a sustainable transport paradigm of managing existing infrastructure (as opposed to building new roads) and improving accessibility.

The Transformation of Truck Transportation September 01, By Leslie Hansen Harps No tags available Join us for a look back at the history of trucking in the United States, lessons motor carriers have learned through the years, and what the road ahead looks like for shippers and carriers. The heightened competition to excel at the supply chain game "has accelerated since the deregulation of trucking," Petty says. Despite challenges such as driver shortages, traffic congestion, increased regulation, rising costs and security issues, truckers continue to find ways to get product to market safely and more efficiently. The highway system was to be graded and lane-separated, with at least four lanes and no traffic lights. Ninety percent of the cost of constructing the system was paid for by the federal government, with the states picking up the remainder. The highways are now owned by the states, who are also responsible for maintenance. Receipts from the federal diesel fuel tax went to the construction of the interstate highways," Gallamore says, noting that the basic arrangements of the Fund have changed little over the years. Today, the Interstate Highway System accounts for nearly one third of the National Highway System, which carries the majority of heavy truck traffic. Trucking has gone through several cycles of regulation and deregulation. Excessive competition around the time of the Depression led to regulation in the s. Following the railroad model, the job of regulating the trucking industry fell to the Interstate Commerce Commission. The ICC established operating authority that gave motor carriers the right to operate on particular routes, handling specified commodities. What Gallamore calls a "patchwork of legalistic, bureaucratic control of routes, rates, and commodities" lasted for roughly half a century. Detter spent the first 16 years of his career in the regulated environment, with the last 24 in the deregulated environment. Before deregulation, "there were fewer competitors. Each carrier had certificates to serve a certain geographic area," Detter recalls. Operating authority was deregulated, and carriers could serve any area in the United States. The years following deregulation were turbulent, with much change taking place. A number of weak carriers went out of business or were acquired, and new, more efficient carriers began operating. Prior to deregulation, the percentage of transportation cost to the total cost of manufacturing and delivering goods was much higher than it is todayâ€”perhaps 50 to 75 percent higher, he notes. Those costs have gone down dramatically. Con-Way companies provide ground expedited; air expedited; less-than truckload regional, inter-regional and transcontinental service; airfreight forwarding; assembly and distribution logistics; truckload and intermodal shipping. Con-Way got its start when deregulation happened, Jerry Detter explains. At the time, Detter was a division manager with Consolidated Freightways. CNF leadership sought investment opportunities that would grow the company going forward. Spotting an opportunity for growth, our parent company decided to invest some of its cash into regional carrier operations that would enhance our sister company at the timeâ€”CF Motor Freight, a long-haul carrier. Detter wrote the business plan in September for what became Con-Way Central Express, a start-up, non-union regional carrier that began operating in June the following year. Con-Way Western Express started up in May But the regional carriers were a success, and customers encouraged them to expand into new, larger geographic areas. Competing Head-to-Head Because the Con-Ways were profitable, the parent company decided to let them go head-to-head against all the competitionâ€”including sister company CF Motor Freight. The Con-Ways continued to grow and expand into new markets. The Central, Southern, and Western operations were linked to cover the entire 48 states. By April , the company had evolved into a fully integrated national network, providing one- and two-day delivery of LTL shipments as well as transcontinental service. Next, the company added a third-party logistics and warehousing capability, and introduced full load and airfreight services. Up to this point, Con-Way has grown the business organically, and will continue to look at new start-up opportunities, Detter says. Founded in as Arkansas Motor Freight, a small local carrier, the company today offers direct service to all 50 states, nine Canadian provinces, Guam, and Puerto Rico, with broad service to Mexico. ABF trucks travel more than one million miles a day, carrying more than 17 million pounds. Louis,

then spreading out to Texas, Chicago, Indianapolis, Ohio, and cities in the south. Over a year period, the company expanded its operating authority to 11 states and changed its name to Arkansas-Best Freight System Inc. We used to have a lot of loose cartons; now everything is palletized, which has speeded the handling process and freed up our docks. Not only has the number of terminals grown, so has the size of those terminals, which can range from 20 to 40 doors to a mega-distribution center with doors. ABF today uses wireless communication technology to increase operational efficiency and visibility. The solution combines Nextel microbrowser technologyâ€"including cell phones with Internet connectionsâ€"and proprietary web-based connections. Using a paperless dock application, for example, supervisors push assignments to yard workers, sending real-time instructions for trailer movement to their handhelds. Drivers report deliveries via the microbrowser, updating the status of the shipment in real time and providing instant visibility for the customer. Getting Methods Down and Controls in Place Well into its eighth decade of operation, the company looks for continued success, Kemp says. Carriers need to have their methods down, good controls in place, and a culture where workers really want to serve customers and get excited about doing it. This culture can be traced back to the s, to the founder of modern-day ABF, R. This culture, he notes, "may be the greatest competitive weapon we have. Ward picked up produce from farmers in central Pennsylvania, and hauled it into New York City where he would peddle it. In , the ICC gave Ward authority to operate in 48 continental states, but it chose to continue as a regional carrier. When deregulation threw up a number of roadblocks, Ward Trucking responded cautiously. Ward retained its customer base, providing a high-end service product. Then the road got a little rocky. Ward Trucking struggled to keep up. Competitors told our customers that we were on the brink of going out of business. There were years when our employees received no pay increases or benefits. Dave Ward became president in and took swift action, making personnel changes at the executive level and in sales and marketing. Throughout the s, Ward Trucking grew organically, adding service centers in locations such as Buffalo, Columbus, and Cincinnati. Two years ago, the company expanded into Virginia, acquiring a carrier with full service centers in Richmond and Winchester. Ward Trucking in decided to become a niche player, operating in a defined geographic area and specializing in unitized, palletized freight. The remake of Ward Trucking is paying off handsomely. We are constantly scanning the market horizon, asking relevancy questions, and studying the competition to learn what they are doing that the marketplace values. Three years later, Schneider acquired a transfer and storage company, then stayed in the moving and storage business until the s. Schneider gradually expanded through acquisition and organic growth. Schneider first surpassed one billion dollars in annual revenue in , Arves notes. The company doubled its revenue four years later; Arves anticipates hitting four billion dollars within the next four or five years. Schneider today has 20, total associates, with 15, drivers and independent contractors. Technology has been a key enabler for Schneider. In , Schneider installed two-way satellite communications in its trucks. It also helped drive out significant cost by improving on-time delivery and enabling greater precision as well as the ability to track equipment. Also in the s, Schneider implemented computer dispatching on a wide-scale basis, as well as a number of cost disciplines. That emphasis on cost containment continues today. Schneider has some 15, tractors and 48, trailers. The company has worked to increase utilization of those assets, running seven percent more miles across each tractor and 20 percent across each trailer in four years. Technology Increases Utilization Schneider today is retrofitting its entire trailer fleet with satellite technology. In addition to knowing its location, Schneider will know whether a trailer is loaded or empty, thanks to sensors in the trailer. This should increase utilization even more. In , the company was incorporated and named Averitt Express. In , Averitt sold the business to Gary Sasser, a young dockworker who had helped him unload his trailer. The company consisted of two associates, three tractors, and five trailers. The company gradually expanded from its Tennessee operations and today offers total coverage in 13 states, serving an area from Cincinnati to Miami, from El Paso to Norfolk. Averitt has added numerous services over the years in order to offer one-stop shopping to transport buyers. Averitt is now in the midst of re-designing its own operation, moving to an integrated approach. Integrating the different operations enables the company to be more effective for customers. The company is also implementing technology that will provide total visibility across all its services and modes, including across carriers with whom it has aligned itself around the world. Moving to a

fully integrated company is just one in a series of transformations for Averitt. The Road Ahead Trucking has evolved significantly in the past 25 years. But the change is far from over, as truckers look for ways to meet the challenges ahead. Ward Trucking has operated in four regulatory environments, according to Dave Ward. In , operating authority was deregulated, enabling companies to operate anywhere they chose to. On top of all these regulations are increased security requirements. New construction technologies and methods make it possible to build highways more quickly and cost-effectively. The Federal Highway Administration, for example, cites prefabricated pavement that snaps together, and concrete that hardens in hours instead of days. While construction technologies have improved, some economists argue that the highways should be built to last for a longer time, Bob Gallamore says, with much thicker pavement and a much deeper infrastructure. Building highways that last longer and require less upkeep would cost more upfront. In addition, more durable highways would likely lead to calls to allow heavier trucks, itself a controversial topic. While technologies and materials are available now to build longer-lasting highways, the rising cost of fuel, coupled with requirements for cleaner-burning fuel, will make it "tough to talk truckers and shippers into an additional increase to pay for better roads," Gallamore notes. Already changing the way truckers operate, congestion may become an even more substantial challenge during the next two decades.

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2: California State Rail Plan

Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.

View gallery - 17 images Public transport systems offer many advantages over the personal alternatives when it comes to getting large numbers of people from A to B in style and safety - less congestion, less pollution and lower costs for starters. There are some radical plans in the works, however, and the 21st Century will undoubtedly bring with it a raft of people moving projects that redefine our notion of public transport. So just what will be pulling into the station in 50 years time? Read on for our pick of the most tantalizing concepts out there. Either way, the idea is not about to fade from our collective imagination and several maglev of the future concepts have been floated. The proponents of this system say that ET3 could be 50 times more efficient than electric cars or trains. Terraspan goes even further than ultra-efficient mass transport with its vision for a network of superconducting tunnels. As well as providing infrastructure for "Terraspan trains," this network would also facilitate zero loss transmission of electricity to our homes. The concept is based on the use of what look like heavy-duty above ground electrical wires, but instead of carrying power, these high-tension wires become the support for carriages. Reversing roles Taking the above ground rail concept further and then turning it on its head is Robert C. Because the design would cause minimal disruption to existing infrastructure and the technology is readily available, Tubular Rail estimates that construction costs could be 60 percent less than conventional urban train networks. The " straddling bus " would roll on stilts above traffic using small tracks positioned between lanes of traffic while passengers get on and off at elevated bus stops. Human-powered mass transport Another outside-the-box approach to transport that deserves a place in our top 10 is the Shweeb. This human powered monorail system uses bicycle pods suspended from tracks to create a very efficient option for getting from A to B. The idea is not limited to adventure parks though. The T-Box envisions turbines incorporated into tracks that could be used to harness wind energy from the train as it whooshes overhead. Power from the road While contactless systems that allow personal electric vehicles to recharge on the go are gathering momentum, these systems also hold potential for making mass transportation greener and more efficient. A real-world example of this technology has already been demonstrated in the form of a trackless "train" developed by researchers at the Korea Advanced Institute of Science and Technology KAIST. So why not just charge the electric train at the socket? While this means gains in efficiency, this needs to be weighed against the loss in efficiency caused by contactless charging, which in the KAIST experiment peaked at 74 percent. KAIST hopes to commercialize this technology within the next few years. Ditching the driver These days we think of road and rail transport as completely different things, but this distinction is set to become a little muddy as technology marches towards One of the benefits of public transport in general is that it avoids the inherent chaos of personal transport where the decisions are made by individual drivers. The system retains the flexibility of purely private transport i. Orbital Maglev Some future transport concepts have loftier goals that just getting us to the station on time. While space tourism based on more conventional rocket ships is a fast growing infant, there are also plans afoot to use "space trains" to launch passengers into orbit. Like the EET discussed above, the Startram system would use a superconducting, magnetically levitating train capsule in a vacuum tube. The difference here is that the final 12 miles 20 km of the 1, mile 1, km long track would point upwards, launching the "carriage" into low earth orbit. George Maise along with one of the inventors of superconducting maglev, Dr. James Powell, the potential of this system to significantly reduce the costs of putting commercial cargo and space tourists into orbit is attracting serious discussion. Space Elevator Another long standing and noteworthy concept that aims to democratize the process of getting off the planet is the space elevator. First theorized over years ago, the idea of the space elevator is to use a cable tethered to a base station to send "climbers" into orbit at a fraction of the cost of rocket-based launch systems. Have we missed something? Technology and creative imagination pushes the limits for innovative ideas for the future and never settles down. Acura combines these two ingredients in

forward thinking with the new Acura ILX. Acura ILX brings you these transportation systems ideas that exhibit world-class innovation and progress.

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3: A Timeline of Transportation

U.S. Senator Charles Schumer argues that a downtown train to the airport and the extension of the number 7 train on the west side must not get lost amid all of the debate over memorials and stadiums.

How Fuel Cells Work Why is it critical that we wean ourselves off oil? Well, there are three main issues. First, in the United States we know we have a problem of oil dependence. Oil makes us dependent on foreign suppliers. It costs our economy hundreds of billions of dollars every year. Second, we have a problem of greenhouse-gas emissions. Our transportation system alone produces more emissions than any country in the world except China. And when that happens, we will have a growing gap between what the world can supply itself in oil and mobility demand, not just in the United States and in Europe and South America, but also in Asia, China, India. Why are we so stuck on it? There are a lot of challenges. Petroleum is times better than batteries, for example, and far better than hydrogen, or even alcohol fuels, or natural gas. And petroleum is relatively cheap. So how do we begin to make the changes we need in our transportation system? Most likely, we want to focus first on the fuel economy of the vehicle itself, as we have in the past. After the first oil crisis in , we made enormous progress in improving the efficiency of vehicles, almost doubling the fuel economy of passenger cars. Over the next 10 or 12 years, we can increase new vehicle efficiency by another 50 percent without having to make smaller vehicles, just by making more efficient engines, more efficient transmissions, slipperier shapes, reduced rolling resistance, and taking some weight out of cars with material substitution. We have to keep going. With the price of oil skyrocketing, Americans are feeling the pain at gas pumps and beginning to change driving behavior. Well, in the near term, we can make changes to conventional gasoline internal combustion engines. There are lots of things that can be done to reduce the internal friction of the engines, for instance. Just tweaking existing engines, if you want to think of it that way, can help improve efficiency by 50 percent. And hybrid vehicles will help. The costs will come down, the batteries will improve, and the numbers of makes and models will increase. Hybrid vehicles will make an increasing impact on the market. Do you think the Prius is a breakthrough? The Prius and the Honda Insight, those hybrids are a huge breakthrough in automotive technology. Hybrids have introduced electricity into transportation. The hybrid is a key technology in that step forward into the future. Even with new technologies like gas-electric hybrids, Greene thinks we still need government policies to set automakers and consumers on a sustainable course. Hydrogen is a very interesting long-term technology. But hydrogen vehicles are not anywhere near ready for the market yet. We would have to replace essentially all of the infrastructure on the fuel supply side. We already have the technology for using ethanol in vehicles, and we now consume about six billion gallons of ethanol every year. That should be cheaper and produce much less greenhouse gas than corn-based ethanol. Then biomass can become a more significant source of energy. Biofuels may help wean us off oil, but corn-based ethanol is still problematic, Greene says. They required passenger cars to increase their fuel economy from about 14 miles per gallon to So we got a significant increase in fuel economy. At the time the standards were passed, light trucks were less than 20 percent of sales. Because of that, and because the light truck standards were not as stringent as the passenger car standards, the on-road fuel economy of vehicles increased by only about 50 percent. There has been a lot of technological progress that could have been used to improve fuel economy, but instead it was used to increase horsepower by about 80 percent. So we have heavier, more powerful vehicles, but about the same fuel economy. Is this a good price for a car? Is this going to be a reliable car? Does it have all the features that they want? Does it convey, you know, who they are? These kinds of things are more important to them at the time they buy the car. But when they own the car, and they use it day after day and they fill it up week after week, then they appreciate the value of fuel economy, I think. At that point, they may be dissatisfied with the fuel economy of their super-size SUV and say, "This is terrible. Why did I buy this? The market for fuel economy has two problems. So we have these two kinds of market failures, if you will, for fuel economy. If the price of gasoline goes up, this will provoke changes but not big changes. Would taxing carbon emissions for vehicles help? But there would be only a one or two percent reduction in carbon emissions from transportation. Why such a small amount? People would drive one

percent less, maybe, and it would also have a small impact on the energy efficiency of vehicles. Government action So what are the policy solutions? Well, we know fuel-economy standards can work. And we know that we have the technology to increase fuel economy by 50 percent over the next 10 or 12 years, and maybe with technological advances, percent over a year period. But the price of dealing with climate change, dealing with our oil security problem, may be giving up the horsepower race and the size race in vehicles. Given recent trends in the auto industry, can that really happen? They just have to not make them bigger and more powerful. Are our cars and trucks powerful enough now, or do we need to have more horsepower? I would say, "For what? Are safety and size linked? The safety argument has been used over the past 20 years to prevent Congress from raising fuel economy. But the argument that increasing fuel economy will decrease highway safety is simply not true. However, from a societal perspective, this is essentially a zero-sum game. What we know from the history of traffic fatalities in the U. We now have data for this over the past 50 years. But are large, heavy vehicles still safer for the individuals in them? The consequences of a crash depend on the ability to slow down the rate of deceleration of the vehicle, and especially the rate of deceleration for the bodies inside. Having a little space, having some size to the vehicle, is helpful. So what we understand now is that we would like to keep the size of the vehicles but take some mass out. Feebates are an alternative to fuel-economy standards that have some very positive attributes. Feebates get around this problem of the consumer not fully considering the value of fuel economy, because the feebate comes at the time of purchase. It essentially affects the price of the car, and we know that people focus on the price of cars, and we know that manufacturers focus on keeping those prices down. Do feebates have any advantages over fuel-economy standards? An advantage of feebates over fuel economy is that when you set out a fuel-economy standard as we set If new fuel-economy technology comes along, they can use it to increase horsepower, they can not use it at all. They can be characterized as a tax. If you are below the fuel-economy target, then you have to pay. Still, the opponents can say, "These people are trying to tax your cars. And that tax has actually been very effective. Everybody else has found that it pays to get whatever technology they need to avoid the gas-guzzler tax. So in a way, we are on an unsustainable path with our foot on the accelerator. You know, this is not prudent behavior. What is most irresponsible is that we are not requiring fuel-economy improvements, that we are not making more use of renewable energy. And we will need societal action to address those. It takes collective action. It takes government action.

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4: This Is What a Smarter 21st-Century Transportation System Will Look Like â€“ Next City

Date: March Transportation Research and Technology: Partnerships for the Next Century. Enhancing transportation research and technology through partnerships was the theme of a special session at the Transportation Research Board's (TRB) annual meeting in January.

Historical Background on Traveling in the Early 19th Century A brief summary of traveling and the impact of changing technology in the early nineteenth-century. Travel in the early nineteenth century was so much slower and more difficult than it is today that it is not easy to remember that it was also a time of significant change and improvement. In New England in , vehicles were few, roads were generally rutted and rudimentary, and traveling any distance was both slow and difficult. Children and poorer adults walked everywhere, and only a minority of farmers had horses and wagons. Many loads of freight were drawn not by horses but by much slower-moving oxen. With a good horse, it took from four to six days, depending on the weather, to travel from Boston to New York. And this was on the best roads, which ran between major cities along the coast. Inland, the roads were even worse, turning to impassable mud when it rained or to choking dust when the weather was dry. More than 3, miles of turnpikes, or toll roads, were built in New England between and Continuing through the s, many thousands of miles of improved county and town roads were constructed as well. The new roads were far better constructed and maintained, and allowed for much faster travel. In response, the number of vehicles on the roads increased rapidly, far faster than population. They made travel, if not enjoyable, at least faster, less expensive, and less perilous than it had ever been. The s had reduced the travel time between Boston and New York to a day and a half. The most radical changes in the speed, scale and experience of traveling came with the application of newly emerging transportation technologiesâ€”the railroad, the steamboat, and the building of canalsâ€”to American conditions. Although steamboats were sometimes dangerously prone to fires and boiler explosions, they traveled faster, met tighter schedules and could travel against the river current far more effectively than rafts and barges. Steamboats vastly expanded passenger travel on the rivers and carried much higher value cargo upstream. Americans turned as well to the massive infrastructure project of canal building, as the British had done decades earlier. Canals promised far less expensive transportation of farm produce, manufactured goods and passengers, but it was often difficult for them to return profits to their investors. In New England, New York and Pennsylvania, Americans created a vast system of inland waterways that significantly reduced transportation costs, although none of them matched the success of the Erie. Its speed and power was unprecedented. With good weather, a good road and rested horses, a stagecoach might manage eight or nine miles an hour. The small locomotives of the s, pulling a handful of cars over uneven track, could travel at fifteen to twenty miles an hour. This was twice as fast, over long distances, as anything Americans had previously experienced. By , miles of railroad track had been laid down, most of it concentrated in the Northeast. This meant that travel between directly connected cities could be much faster than before; a trip between Boston and Worcester now took less than 2 hours, and travelers could reach New York City from Boston in less than a day, using both coastal steamship and railway. But before only a relatively small minority of Americans had felt its impact, and railway travel was both noisy from the grating and squealing of iron wheels on the tracks and dirty from showers of ash and cinders from wood-burning locomotives. The years between and saw a true revolution in transportation even before the coming of the railroad. By , transportation costs had been greatly reduced and travel had become faster by a factor of 5 or more. Many ordinary Americans could now become travelers for pleasure and even the pathways of westward migration had become much faster and safer.

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5: Transport in China - Wikipedia

Now that hoopla surrounding introductions of new cars and trucks has dropped to the normal hype, it's time to get on with the idea of designing a transportation system for well into the next century. After all, in a little over six years the 21st century will be here, and, to put it simply, we're.

Trams in China Several cities in China had tram systems during the 20th century; however, by the end of the century, only Dalian , Hong Kong and Changchun remained. Commuter rail systems, characteristic of large European and North American cities, were initially uncommon in China. Rail Transit in the special administrative regions[edit] Main articles: Mass Transit Railway and Macau Light Transit System Hong Kong Mass Transit Railway was planned, designed, constructed and opened under British administration ; it was opened in and merged with the KCR network in to form a line heavy metro operation and a modern light rail network. In addition, a tramway system operates on Hong Kong Island. The Macau LRT was first proposed in , but a final go-ahead was not given until a public announcement by the Government of Macau in October Many Chinese still use motorbike or e-bike seen here parked on a Shanghai street to get around, but it is forbidden in some major cities. China National Highways and Expressways of China During the war with Japan , in the s, China built many roads, the most famous of which is the Burma Road that leads southwest from Kunming to the city of Lashio. Since it came into power, the Communist government initiated a large effort into building highways that extend across China and beyond its borders. Today, China is linked by an evolving network of highways China National Highways and expressways Expressways of China. In the past few years, China has been rapidly developing its road network. Between and , the total length of urban roads in China more than doubled; increasing from 95, to , kilometers of roads during that period. Similarly, during the same period of time, the total area allocated to roads more than tripled; from million square meters in , to 3, Expressways reach the same destinations as China National Highways , except for the rugged terrain of Tibet. An expressway link is already at the planning stage. The highway and road systems carried nearly The importance of highways and motor vehicles , which carry Automobile usage has increased significantly in urban areas as incomes rise. However, car ownership is still low in comparison to the other members of the BRIC group of countries, being exceeded by Russia and Brazil. In China reported that Beijing currently has the highest annual rate of private car growth in China, leading to major congestion in the capital. In China had a total road network of more than 3. The construction plan comprises five north-south highway trunk roads and seven east-west trunk roads and eight inter-provincial roads. Meanwhile, the central and local governments have continued to allocate funds to support the countryside highway build-up and step up construction quality supervision. Note the doors on the left-hand side of the bus -- the BRT line uses central island platforms for most of its route. More than 30 projects are being implemented or studied in China in some big cities. Shuttle buses like this link smaller towns with regional centers.

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6: Building Transportation for the Next Century: We Can Do it All

Surface transportation research needs for the next century, parts I and II: hearings before the Committee on Science, Subcommittee on Technology, U.S. House of Representatives, One Hundred Fifth Congress, first session, February 27 and April 23,

Brian Slack and Dr. They are mobile transport assets and fall into one of three basic types, depending on over what surface they travel; land road, rail and pipelines , water shipping , and air. A Diversity of Modes Transport modes are designed to either carry passengers or freight , but most modes can carry a combination of both. For instance, an automobile has a capacity to carry some freight while a passenger plane has a bellyhold that is used for luggage and cargo. Main Passenger Modal Options Performance Comparison for Selected Freight Modes Atomization versus Massification in Transportation Modes Road transportation Road infrastructures are large consumers of space with the lowest level of physical constraints among transportation modes. However, physiographical constraints are significant in road construction with substantial additional costs to overcome features such as rivers or rugged terrain. While historically road transportation was developed to support non-motorized forms of transportation walking, domestication of animals and cycling at the end of the 19th century , it is motorization that has shaped the most its development since the beginning of the 20th century. Road transportation has an average operational flexibility as vehicles can serve several purposes but are rarely able to move outside roads. Road transport systems have high maintenance costs, both for the vehicles and infrastructures. They are mainly linked to light industries where rapid movements of freight in small batches are the norm. Yet, with containerization, road transportation has become a crucial link in freight distribution. In light of more recent technological developments, rail transportation also include monorails and maglev. They have an average level of physical constrains linked to the types of locomotives and a low gradient is required, particularly for freight. Heavy industries are traditionally linked with rail transport systems, although containerization has improved the flexibility of rail transportation by linking it with road and maritime modes. Rail is by far the land transportation mode offering the highest capacity with a 23, tons fully loaded coal unit train being the heaviest load ever carried. Pipeline routes are practically unlimited as they can be laid on land or under water. The longest gas pipeline links Alberta to Sarnia Canada , which is 2, km in length. The longest oil pipeline is the Transiberian, extending over 9, km from the Russian arctic oilfields in eastern Siberia to Western Europe. Physical constraints are low and include the landscape and pergelisol in arctic or subarctic environments. Pipeline construction costs vary according to the diameter and increase proportionally with the distance and with the viscosity of fluids from gas, low viscosity, to oil, high viscosity. Pipeline terminals are very important since they correspond to refineries and harbors. Major Gauges of the Global Rail Systems, Trans-Alaska Pipeline Maritime transportation Because of the physical properties of water conferring buoyancy and limited friction, maritime transportation is the most effective mode to move large quantities of cargo over long distances. Main maritime routes are composed of oceans, coasts, seas, lakes, rivers and channels. However, due to the location of economic activities maritime circulation takes place on specific parts of the maritime space, particularly over the North Atlantic and the North Pacific. The construction of channels, locks and dredging are attempts to facilitate maritime circulation by reducing discontinuity. Maritime transportation has high terminal costs, since port infrastructures are among the most expensive to build, maintain and improve. High inventory costs also characterize maritime transportation. More than any other mode, maritime transportation is linked to heavy industries, such as steel and petrochemical facilities adjacent to port sites. Air transportation Air routes are practically unlimited, but they are denser over the North Atlantic, inside North America and Europe and over the North Pacific. Air transport constraints are multidimensional and include the site a commercial plane needs about 3, meters of runway for landing and take off , the climate, fog and aerial currents. Air activities are linked to the tertiary and quaternary sectors, notably finance and tourism, which lean on the long distance mobility of people. More recently, air transportation has been accommodating growing quantities of high value freight and is playing a growing role in global logistics. Intermodal transportation Concerns a variety of modes used in combination so

that the respective advantages of each mode are better exploited. Although intermodal transportation applies for passenger movements, such as the usage of the different, but interconnected modes of a public transit system, it is over freight transportation that the most significant impacts have been observed. Containerization has been a powerful vector of intermodal integration, enabling maritime and land transportation modes to more effectively interconnect. Telecommunications Cover a grey area in terms of if they can be considered as a transport mode since unlike true transportation, telecommunications often do not have a physicality. Yet, they are structured as networks with a practically unlimited capacity and very low constraints, which may include the physiography and oceanic masses that may impair the setting of cables. Wave transmissions, because of their limited coverage, often require substations, such as for cellular phone networks. Satellites are often using a geostationary orbit which is getting crowded. High network costs and low distribution costs characterize many telecommunication networks, which are linked to the tertiary and quaternary sectors stock markets, business to business information networks, etc. Telecommunications can provide a substitution for personal movements in some economic sectors. However, contemporary demand is influenced by integrated transportation systems that require maximum flexibility in the respective use of each mode. As a result, modal competition exists at various degrees and takes several dimensions. Modes can compete or complement one another in terms of cost, speed, accessibility, frequency, safety, comfort, etc. There are three main conditions that insure that some modes are complementing one another: It is clear that if different markets are involved, modes will permit a continuity within the transport system, particularly if different scales are concerned, such as between national and international transportation. This requires an interconnection, commonly known as a gateway, where it is possible to transfer from one mode to the other. Intermodal transportation has been particularly relevant to improve the complementarity of different geographical markets. The nature of what is being transported, such as passengers or freight, often indicates a level of complementarity. Even if the same market area is serviced, it may not be equally accessible depending of the mode used. Thus, in some markets rail and road transportation can be complementary as one may be focusing on passengers and the other on freight. Different levels of service. For a similar market and accessibility, two modes that offer a different level of service will tend to complement another. The most prevailing complementarity concerns costs versus time. Thus, there is modal competition when there is an overlap in geography, transport and level of service. While maritime transport might offer the lowest variable costs, over short distances and for small bundles of goods, road transport tends to be most competitive. A critical factor is the terminal cost structure for each mode, where the costs and delays of loading and unloading the unit impose fixed costs that are incurred independent of the distance traveled. At the same time, international trade in manufactured goods and parts has increased. These trends in travel demand act differently upon the modes. Those that offer the faster and more reliable services gain over modes that might offer a lower cost, but slower, alternative. For passenger services, rail has difficulty in meeting the competition of road transport over short distances and aircraft for longer trips. For freight , rail and shipping have suffered from competition from road and air modes for high value shipments. While shipping, pipelines and rail still perform well for bulkier shipments, intense competition over the last decades have seen road and air modes capture an important market share of the high revenue-generating goods. Road transport clearly dominates. Although intermodal transportation has opened many opportunities for a complementarity between modes, there is intense competition as companies are now competing over many modes in the transport chain. A growing paradigm thus involves supply chain competition with the modal competition component occurring over three dimensions: Competition that involves the comparative advantage of using a specific or a combination of modes. Distance remains one of the basic determinants of modal usage for passenger transportation. However, for a similar distance, costs, speed and comfort can be significant factors behind the choice of a mode. Competition resulting from the presence of freight and passenger traffic on the same itineraries linking the same nodes. Each level of capacity used by a mode is therefore at the expense of the other mode. Competition being experienced between transport terminals for using new space terminal relocation or expansion or capturing new markets hinterland. Forms of Modal Competition Modal Split in the United States by Passenger Travel Distance, It is generally advocated that a form of modal equality or modal neutrality should be part of public policy where each mode

would compete based upon its inherent characteristics. Since different transport modes are under different jurisdiction and funding mechanisms, modal equality is conceptually impossible as some modes will always be more advantageous than others. Modal competition is influenced by public policy. This particularly takes place over government funding of infrastructure and regulation issues. Roads are usually provided by the public sector, while many other transport infrastructures are financed by the operators using them. This is the case for rail, air and maritime transportation. Under such circumstances, public policy shapes modal preferences. Modal Shift The technological evolution in the transport industry aims at adapting the transport infrastructures to growing needs and requirements. When a transport mode becomes more advantageous than another over the same route or market, a modal shift is likely to take place. A modal shift involves the growth in the demand of a transport mode at the expense of another, although a modal shift can involve an absolute growth in both of the concerned modes. The comparative advantages behind a modal shift can be in terms of costs, convenience, speed or reliability. For freight , this has implied a shift to faster and more flexible modes when possible and cost effective, namely trucking and air freight. Modal shift can further be nuanced by time shift, for which the use of the same mode takes place at another time period, likely when there is less congestion. In a situation of congestion, it is thus likely that time shift will be preferred to modal shift, particularly if the time shift is relatively marginal e. There are important geographical variations in modal competition. The availability of transport infrastructures and networks varies enormously, with corridors being subject to the most modal competition. Some regions possess many different modes that in combination provide a range of transport services that ensure an efficient commercial environment. Thus, in contrast to the situation in the European Union, rail freight transport occupies a more important market share in North America but passenger rail has a negligible share. In many parts of the world, however, there are only limited services, and some important modes such as rail may be absent altogether. This limits the choices for passengers and shippers, and acts to limit accessibility. People and freight are forced to use the only available modes that may not be the most effective to support their mobility. Areas with limited modal choices tend to be among the least developed. Advanced economies, on the other hand possesses a wide range of modes that can provide services to meet the needs of society and the economy. Since fuel prices gave increased significantly as well as their volatility, illustrated by significant price declines in and All modes are affected by fuel price volatility , from the individual car owner to the corporation operating a fleet of hundreds of aircraft or ships. Different pricing mechanisms are used, namely direct rate adjustments, as is the case of shipping, or indirect adjustments as is the case of airlines, with the reliance on fuel surcharges when energy prices are increasing. In the context of higher energy prices and environmental concerns, and therefore higher input costs for transportation, the following can be expected:

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The Neptune , a 19th-century convict ship that brought prisoners to Australia In England in the 17th and 18th centuries criminal justice was severe, later termed the Bloody Code. This was due to both the particularly large number of offences which were punishable by execution, usually by hanging , and to the limited choice of sentences available to judges for convicted criminals. With modifications to the traditional Benefit of clergy , which originally exempted only clergymen from civil law, it developed into a legal fiction by which many common offenders of "clergyable" offenses were extended the privilege to avoid execution. With the development of colonies, transportation was introduced as an alternative punishment, although legally it was considered a condition of a pardon, rather than a sentence in itself. A secondary aim was to discourage crime for fear of being transported. It was a solution to a real problem in the domestic penal system. In , in the reign of James I , a committee of the Council had already obtained the power to choose from the prisoners those that deserved pardon and, consequently, transportation to the colonies. Convicts were chosen carefully: These bills failed, but it was clear that change was needed. The reading test, crucial for the benefit of clergy , was a fundamental feature of the penal system, but in order to prevent its abuse, this pardoning process was used more strictly. Prisoners were carefully selected for transportation based on information about their character and previous criminal record. It was arranged that they fail the reading test, but they were then reprieved and held in jail, without bail, to allow time for a royal pardon subject to transportation to be organised. They obtained a contract from the sheriffs, and after the voyage to the colonies they sold the convicts as indentured servants. The colonial opposition was one of the main obstacles: Maryland and Virginia enacted laws to prohibit transportation in , and the king was persuaded to respect these. Nevertheless, it could be argued that transportation was economically deleterious because the aim was to enlarge population, not diminish it; [22] but the character of an individual convict was likely to harm the economy. In the post-war period there was more crime [23] and hence potentially more executions, and something needed to be done. In the reigns of Queen Anne â€”14 and George I â€”27 , transportation was not easily arranged, but imprisonment was not considered enough to punish hardened criminals or those who had committed capital offences, so transportation was the preferred punishment. In the reading test for claiming benefit of clergy was abolished 5 Anne c. This allowed judges to sentence "clergyable" offenders to a workhouse or a house of correction. It legitimised transportation as a direct sentence, thus simplifying the penal process. A sentence of fourteen years was imposed on prisoners guilty of capital offences pardoned by the king. Returning from the colonies before the stated period was a capital offence. He was a prominent sentencing officer at the Old Bailey and the man who gave important information about capital offenders to the cabinet. The system of sponsorship by merchants had to be improved. The Treasury also paid for the transportation of prisoners from the Home Counties. With the exception of those years, the Transportation Act led to a decrease in whipping of convicts, thus avoiding potentially inflammatory public displays. Clergyable discharge continued to be used when the accused could not be transported for reasons of age or infirmity. Men, women, and children were sentenced to transportation, but its implementation varied by gender and age. From to , highway robbery, burglary , and horse theft were the offences most often punishable with transportation for men. In those years, five of the nine women who were transported after being sentenced to death were guilty of simple larceny, an offence for which benefit of clergy was not available for women until All these factors meant that most women and children were simply left in jail. The reverse was true when women were sentenced for a capital offence, but actually served a lesser sentence due to a manipulation of the penal system: One advantage of this sentence was that they could be discharged thanks to benefit of clergy while men were whipped. Finding alternative locations to send convicts was not easy, and the act was extended twice by the Criminal Law Act 18 Geo. Act 24 Geo. Act 25 Geo. Both acts empowered the Crown to appoint certain places within his dominions, or

outside them, as the destination for transported criminals; the acts would move convicts around the country as needed for labour, or where they could be utilized and accommodated. The overcrowding situation and the resumption of transportation would be initially resolved by Orders in Council on 6 December , by the decision to establish a penal colony in New South Wales , on land previously claimed for Britain in , [46] [47] but as yet unsettled. The British policy toward Australia, specifically for its use as a penal colony , within their overall plans to populate and colonise the continent, would differentiate it from America, where the use of convicts was only a minor adjunct to its overall policy. The act also gave "authority to remit or shorten the time or term" of the sentence "in cases where it shall appear that such felons, or other offenders, are proper objects of the royal mercy" [50] At the beginning of the 19th century, transportation for life became the maximum penalty for several offences which had previously been punishable by death. Although a concerted program of prison building ensued, the Short Titles Act lists seven other laws relating to penal transportation in the first half of the 19th century. During the 80 years of its use to Australia, the number of transported convicts totaled about , men and women. In the 17th century transportation was carried out at the expense of the convicts or the shipowners. In , an extension authorised payments by the Crown to merchants contracted to take the convicts to America. The Transportation Act made returning from transportation a capital offence. Maryland received a larger felon quota than any other province. After the termination of transportation to North America, British prisons became overcrowded, and dilapidated ships moored in various ports were pressed into service as floating gaols known as "hulks". From the s until the s, convicts were sent to Bermuda to work on the construction of the Royal Naval Dockyard and other defence works, including an area still known as "Convict Bay", at St. Transportation to Australia[edit] Main article: Convicts in Australia This notice on a bridge in Dorset warns that damage to the bridge can be punished by transportation. In , the " First Fleet " of convict ships departed from England to establish the first British settlement in Australia, as a penal colony. Norfolk Island was a convict penal settlement from â€”94, and again from The First Fleet included boats containing food and animals from London. The ships and boats of the fleet would explore the coast of Australia by sailing all around it looking for suitable farming land and resources. The other Australian colonies were "free settlements", as non-convict colonies were known. However, the Swan River Colony Western Australia accepted transportation from England and Ireland in , to resolve a long-standing labour shortage. Until the massive influx of immigrants during the Australian gold rushes of the s, the free settlers had been outnumbered by English and Irish convicts and their descendants. However, compared to America, Australia received many more English prisoners. Transportation from Britain and Ireland officially ended in , although it had become uncommon several years earlier. The transportations had a twofold objective - to remove potential liabilities from the warfront, and to provide human capital for the settlement and industrialization of the largely underpopulated eastern regions. The policy continued until February of , when Nikita Khrushchev in his speech On the Personality Cult and its Consequences condemned the transportation as a violation of leninist principles. Whilst the policy itself was rescinded, the transported populations did not begin to return to their original metropoles until after the collapse of the Soviet Union, in About 22, criminals and political prisoners most notably Communards were sent to New Caledonia. The most famous transported prisoner is probably French army officer Alfred Dreyfus , wrongly convicted of treason in a trial in , held in an atmosphere of antisemitism. Folk Song and Literature[edit] Penal transportation is a feature of many broadsides , and a number of these transportation ballads have been collected from traditional singers. Magwitch, who had been apprehended shortly after the young Pip had helped him, was thereafter sentenced to transportation for life to New South Wales in Australia. While so exiled, he earned the fortune that he later would use to help Pip. Penal transportation, typically to other planets, sometimes appears in works of science fiction. A classic example is The Moon is a Harsh Mistress by Robert Heinlein , in which convicts and political dissidents are transported to lunar colonies.

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Penal transportation or transportation was the relocation of convicted criminals, or other persons regarded as undesirable, to a distant place, often a colony for a specified term; later, specifically established penal colonies became their destination.

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