

**Transportation Impacts
of E-Commerce**

Eric Plosky

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Prof. Stephen Graham
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Introduction.

The popular press has lately lavished much attention on e-commerce — transactions, involving the purchase and delivery of goods and services, conducted over the Internet. The numbers associated with e-commerce bespeak unbelievably rapid growth and increasing importance to the national — the worldwide — economy.

By the end of 1999, 38 percent more Americans were surfing the Internet than in December 1998. E-commerce traffic increased by 44 percent — nearly 9 million households shopped online, 4.4 million for the first time. Forrester Research predicted that online sales in the December '99 holiday period would nearly triple from the previous year's — up to \$4 billion from a mere \$1.5 billion. Nearly one-third of that spending would be on 'convenience' goods such as apparel, books, and CDs. And e-commerce is just getting off the ground; by 2003, Forrester envisages the total value of all American e-commerce transactions adding up to \$1.3 trillion — by then comprising nearly one-tenth of total retail sales. (Forrester, Wired, Sheffi)

Some of the other numbers associated with e-commerce are just as extraordinary, but much less prominent in the press. Many such numbers are associated with the United Parcel Service (UPS), a freight transportation company that delivers many of the goods ordered in e-commerce transactions. In 1998, UPS delivered over 3 billion packages — more than one-tenth of them in December. Between November 23 and December 16, 1999, UPS had already delivered nearly 300 million packages; "as expected, UPS is seeing a surge in e-commerce-related deliveries this holiday season," noted UPS's web site. Enthusiasm for UPS with respect to e-commerce prompted the company to go public in November 1999; it raised some \$5.5 billion in the country's largest-ever initial public offering.

The UPS numbers illustrate that e-commerce is significantly, and rapidly, changing the nature of transportation in the United States. Freight transportation — and passenger transportation as well — is, in fact, undergoing a radical transformation as a result of e-commerce, although most people seem not to be taking much notice of it. The press has placed far more emphasis on e-commerce's promised socioeconomic benefits than it has on e-commerce's transportation impacts.

This paper discusses the transportation impacts of e-commerce. Changes to passenger and freight transportation systems are analyzed, with respect to the available statistical data, and a number of important questions are posed, questions to which, unfortunately, there are not yet definitive answers. Due to space and scope constraints, this paper does not examine the reasons for popular ignorance of e-commerce's transportation impacts. The essay does, however, conclude with a series of possible future scenarios, constructed from three different perspectives, that attempt to answer the questions posed.

Overview of E-Commerce.

It is only a slight simplification to say that in 1997, there was no e-commerce. Pioneering online retailers like Amazon had begun to sell books, computer manufacturers such as Dell sold PCs, and it was possible to buy a motley assortment of goods and services in between. But e-commerce was still fetal; its impacts were very limited.

Less than three years later, e-commerce has become big business indeed, not only in terms of sheer total sales but in terms of the breadth and variety of goods and services now offered. Forrester Research's estimate that \$4 billion would be spent online in the 1999 holiday period covers expenditures on a dizzying array of products, from groceries to pharmaceuticals to airplane tickets. It is possible today, quite literally, to buy nearly anything you want online; food, books, CDs and DVDs, clothes, electronics, appliances, cosmetics — all can be delivered to your door.

Therein lies a rub, a situation analogous to that described by Paul Levy, former executive director of the Massachusetts Water Resources Authority, the Boston-area water and sewer system. "We once did a survey asking people where they thought their sewage went when they flushed the toilet," said Levy. "Ninety percent of people said: 'away.'" Similarly, most customers never consider how the goods and services procured through e-commerce transactions are actually delivered to their doorstep. The process, from the consumer's end, is relatively opaque — a shopper clicks "buy" on a web site, and n time later, the purchase is handed to her by a uniformed deliveryman.

For reasons beyond the scope of this paper, the press, in discussing e-commerce, has never focused on the potential transportation impacts — with one notable exception. Facile claims abound that the advent of e-commerce will make it

possible for people to spend, in the aggregate, so much less time on the road to and from traditional retail stores that traffic congestion will become a thing of the past. E-commerce is heralded as that which will end urban gridlock, eliminate pollution, and restore order to our shapeless, sprawling suburbs.

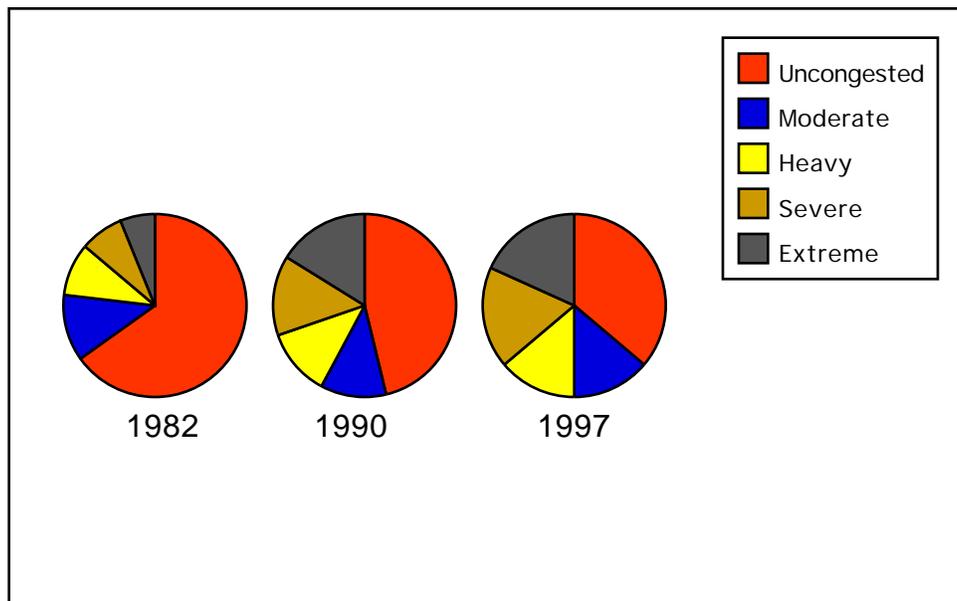
If little time is spent discussing the passenger transportation impacts of e-commerce, no thought is given over at all to e-commerce's potential to reshape the freight transportation system. This is troubling. If Forrester's predictions are true, within five years one-tenth of the national economy will have turned around — instead of leaving their homes to purchase all their goods and services traditionally, consumers will stay at home ten percent of the time, waiting for goods and services to be delivered to them. That would mean further huge changes in the freight transportation industry. Glib hypotheses advanced by e-commerce boosters are insufficient to understand this critical transformation; a detailed analysis is necessary, in order that we may be able to plan for and take full advantage of the changes that are to result from increasing e-commerce.

E-commerce is linked closely with other modern-day phenomena that together have awesome potential to reshape passenger and freight transportation — telecommuting, just-in-time freight-delivery techniques, and intelligent transportation systems, to name but a few. It is not possible to learn anything from proselytizing or prognosticating. The changes to passenger and freight transportation must be carefully examined and questioned.

Changes to Passenger Transportation.

The long-term passenger transportation impacts of e-commerce are largely unknown. Technological utopians hail e-commerce; they believe e-commerce makes traveling to Main Street or the mall unnecessary. The resultant benefits of fewer shopping trips will be less congestion and less pollution.

It is more than a bit optimistic to claim that e-commerce will have any significant hand in reducing passenger travel. Private travel by automobile has been increasing since the beginning of the century, dramatically so since the Second World War, with passenger-miles traveled increasing so quickly that the national per-capita rate has been increasing. (Downs) Furthermore, congestion has increased tremendously, even in the 1990s. The Texas Transportation Institute provides the following congestion data for major American metropolitan areas:



Data from the Texas Transportation Institute's Urban Mobility Study, 1999. (The pie charts indicate the percentage of roads falling into each of the labeled categories in each metropolitan area.)

Proponents of e-commerce, however, are likely to claim that the advent of e-commerce will fundamentally change the historical trend toward increased automobility. They point to the increasing prevalence of telecommuting, the growing popularity of Toffleresque “electronic cottage” arrangements whereby people work at home, and insist that when e-commerce begins to grow, passenger travel by automobile will rapidly decline. (Toffler, quoted in Graham)

Telecommuting by itself has not reduced individual automobility. The number of American telecommuters has been increasing since the 1970s, with no consequent decrease in passenger-miles. (Hows, Downs, TTI) Some have argued that increased work-schedule flexibility has reduced the number of journeys to work, but that that reduction has enabled a sizable increase in the number of journeys undertaken for non-work purposes. In a similar manner, journeys might be eliminated by e-commerce, only to make possible new trips for non-shopping purposes.

It is difficult to say; there are many contradictions. For instance, even with the advent of telecommuting, average commute times and distances have continued to increase, and congestion has more than kept pace. (Downs, TTI) It is not illogical, therefore, to tentatively conclude that increasing e-commerce will actually enable a new set of shopping journeys. Consider this example: A person who uses e-commerce to buy his groceries, and therefore no longer needs to go to the supermarket, has more time to drive to and from the mall, buying leisure and convenience items.

This paradox — that e-commerce would actually help to continue to *increase* passenger transportation, even for shopping purposes — is difficult to test. Different groups are frantically conducting multiple studies of e-commerce and Internet usage, with markedly different results. Political objectives behind these studies often obscure their actual statistical import, which can be hard to quantify

anyway. For example, one recent e-commerce study, conducted by the Center for Energy and Climate Solutions, claimed that 40 percent of people with Internet access “say they go to malls or stores less often.” (Globe) This finding, if it is a finding, is subject to various interpretations. E-commerce boosters would hail the result, for it seems to indicate an overall reduction in passenger-miles traveled. But does it? What happened to the other 60 percent of people with Internet access? Did their travel patterns not change at all, or did they actually initiate new shopping trips, increasing their overall travel?

Forrester Research notes an increasing number of people, distinct from those who actually buy goods and services online, who use e-commerce tools to research potential purchases online. They then go to purchase the researched items at their local stores. With such sparse statistics available, it is difficult to extrapolate a trend out of this. But it is conceivable that the proliferation of access to e-commerce tools will enable millions more consumers to research products online, and then purchase them locally. (Forrester)

Short- and long-term timelines may differ. That is, the passenger transportation impacts of e-commerce may be felt in distinct phases. In one hypothetical situation, e-commerce may initially create new passenger trips, as consumers research goods online but then purchase them locally. As e-commerce grows, however, more actual purchases are conducted online, and passenger transportation decreases. But as an increasing number of goods and services are delivered directly, consumers find themselves with the time to embark upon new journeys, for various purposes.

There are any number of scenarios, and the spotty data mean that plausible arguments can be constructed for many of them. The most definitive statement that can be made is that it is naïve to claim to know what the eventual passenger transportation impacts of e-commerce will be.

Changes to Freight Transportation.

E-commerce's impacts on freight transportation are more readily understood, for the effects are already quite perceptible. Nothing short of a revolution in freight transportation is underway, as the freight transport industry prepares for staggering growth into the twenty-first century. There are a number of changes too detailed to discuss here beyond a brief mention — new warehouse and logistics systems, new methods of delivery, new transportation and supply-chain management techniques. (Sheffi)

At the more visible metropolitan level there are a host of new developments. Delivery trucks from firms like Federal Express and the United Parcel Service (UPS) carry e-commerce purchases directly to households in larger numbers than ever before. UPS, Federal Express, and the United States Postal Service (USPS) have all increased the size of their delivery fleets considerably over the past few years — the USPS's fleet alone now numbers nearly 200,000 ground vehicles; UPS's fleet, nearly 150,000 ground vehicles. (USPS, UPS)

There are more trucks because there are more packages, but also because of a change in delivery techniques. Overnight delivery, first popularized in the 1970s by Federal Express, continues to grow in popularity, as e-commerce vendors compete to see who can deliver their products the fastest. (Yahoo-F) To ensure that packages shipped overnight arrive on time, shippers have had to expand truck fleets well beyond the actual required capacity, and as a result more vehicles are traveling less full — and more frequently. Truck manufacturers' stock is at an all-time high. (Sheffi) By this measure, environmentalists should be upset.

More upsetting from an environmental standpoint is the increased number of aircraft required to meet e-commerce shipping demands. In early December 1999, UPS announced that it would acquire seven Airbus freighters in 2000 instead of the

four originally planned, due to “significant growth in the air express business,” no doubt a result of e-commerce. A UPS press release noted that in October 1999, next-day air shipments rose by nearly 15% from the previous year, while 2- and 3-day delivery rose by over 12%. (UPS)

But it is delivery trucks that are currently the largest concern. Increasing numbers of trucks, whether full or half-empty, pose a great many problems with respect to existing urban transportation infrastructures. The fact that more trucks will simply be on streets, taking up space and contributing to pollution problems, is only the first such problem.

Trucks create additional traffic congestion while loading or unloading in areas not specifically designated as freight loading/unloading zones. As current economic trends continue, and every type of office from single-suite startups to soaring urban skyscrapers demands more goods delivered directly, trucks actually performing deliveries will continue to worsen urban congestion.

Trucks are larger, slower and less agile than cars, and do not fit into standard parking spaces. The current practice of shippers, assigning one employee per delivery truck, means that the driver is also the actual deliverer — in other words, the driver has to pull up to his destination and leave the truck idling (or parked) immediately outside while he brings packages inside, thereby causing traffic havoc. Only the largest facilities in urban areas have off-street loading docks; but even so, those were constructed to service fully loaded tractor-trailers, not half-empty conversion vans.

The unpredictability of freight transport makes it impossible to predict freight traffic; unlike with passengers, there is no well-defined “rush hour.” Packages can arrive at the start of the business day, in the middle, at the end, or even at night or on weekends; there is no way to tell in advance what a day’s freight traffic will look like. That is because package delivery times depend on complicated

logistics worked out by shippers that correspond to the number of other packages that must be delivered on a given day within a certain geographical area. As more businesses and individual consumers order more and more goods via e-commerce, and as more orders consist of single impulse or convenience purchases, shippers' logistics will become even more complicated, and a single, well-defined delivery pattern is unlikely to emerge.

Modern transportation and delivery technology has made it possible for consumers and businesses to rely on so-called "just-in-time" delivery, a scheme that dispenses with traditional stocking of goods in favor of having them delivered only when immediately needed. As Jane Q. Public shifts from driving to the grocery store every Wednesday afternoon to placing individual e-commerce orders for broccoli rabe and turnips when she runs out of those particular items, the freight transportation mechanisms required to support her consumption will grow ever more dizzyingly complicated, and congestion will be that much more difficult to predict and to mitigate.

And what about returns? Up to ten percent of e-commerce deliveries are eventually returned or exchanged. (Sheffi) Shippers have had, increasingly, to equip their fleets and delivery-van drivers to enable two-way transportation of goods. But this development, too, makes it difficult to foresee the congestion effects of changed freight transportation. E-commerce means that deliveries and freight congestion are becoming nearly impossible to predict anyway; the added variable of returns simply adds yet another dimension of complexity.

Urban design responses.

Although no one is yet certain of the ultimate effects e-commerce will have on passenger and freight transportation, public authorities are already formulating responses that attempt to mitigate the initial effects — particularly increased urban congestion as a result of expanded freight transportation. These responses generally fall into one of three categories. *Policy* responses aim, via traditional regulatory means, to restrict or control transportation in such a way as to discourage further congestion. *Infrastructure* responses actually modify the urban architecture in order to accommodate new passenger and freight transportation behaviors that result from e-commerce. *Paradigm* responses promote changes in consumer and/or government behavior in an attempt to accommodate the effects of e-commerce.

These responses to the transportation impacts of e-commerce take various forms. Some are already manifest; others are merely theoretical, and some are doubtless being proposed for the first time in this essay. They are all, however, worth discussion. Depending on which responses actually endure, a feedback cycle may be established — in other words, for instance, e-commerce causes a particular change in the transportation system, which spurs a particular response, which itself accelerates the initial change, and so on. Because they are so important, therefore, it is just as critical to examine responses to e-commerce's transportation impacts as it is to examine the impacts themselves.

Urban design responses — Policy.

Worsening urban transportation and environmental conditions as a result of increased freight traffic has led many municipalities to restrict truck traffic. The city of Cambridge, Massachusetts, for instance, endlessly debates in its City Council proceedings the merits of restricting truck traffic, on the basis not only of transportation and environmental concerns but because trucks passing through late at night, destined for regional freight distribution centers, often wake up the locals. (Cambridge)

Policy modifications are being considered in many cities concerned about worsening transportation and environmental conditions. Some proposals would ban delivery trucks (called, in regulatory argot, ‘commercial vehicles’) in certain districts or at certain times of day. Many schemes would restrict freight deliveries during rush hours, when passenger-car congestion is at its urban worst.

Such policies are not far-fetched. Many roads are already off-limits to commercial vehicles; other roads are time-restricted. (In many residential neighborhoods, for instance, local deliveries are permitted only during the working day.) But new regulatory responses to e-commerce-induced freight transportation congestion are schizoid. Some policymakers want to ban truck traffic at night and on weekends; others want to alleviate congestion during the business day by confining freight deliveries to those hours. The principal concerns are at odds — some place paramount importance on being able to sleep at night without trucks rumbling through the neighborhood; others are more concerned with urban gridlock during rush hour. Until these motivational conflicts are resolved, new regulations are not likely to make much sense.

Besides, policymakers desperate to pass new regulatory measures often overlook that such measures are likely to be extremely unpopular among the

relatively wealthy elite who now participate in e-commerce. For example, banning freight deliveries from certain areas would necessitate the creation of an alternative delivery model, such as regional delivery centers. And prohibiting deliveries at certain times would force a change in consumer behavior that is already well-established, even with respect to e-commerce. Although e-commerce is only now beginning to take off, consumers are already well accustomed to being able to receive goods at their homes precisely when the goods are wanted. Regulatory shifts that reduce overall service quality are apt to be met with extreme disfavor.

Also, it is easy to overlook the fact that regulatory responses by themselves are sometimes useless. A city like Boston or New York, both of which have recently tried to curb urban congestion by cracking down on illegally parked or idling cars, might view a logical next step as ticketing delivery vans that are, in the process of delivering their goods, technically parked or idling illegally. But what's the point? If there are no alternatives, a delivery-van driver is just going to have to park or idle in a no-standing or no-stopping zone, or in front of a fire hydrant. To solve problems such as this, policy proposals can be viewed as only part of a potential solution.

A more sophisticated form of regulatory response is road pricing. Something of a free-market approach to the problem of congestion, road pricing advocates believe that by introducing a sliding road-cost scale, Adam Smith's 'invisible hand' can well be applied to evening out traffic. (Downs) Shippers might be obliged to pay certain tolls to enter certain areas at certain times of day. Or, depending on the level of sophistication desired, tolls can be keyed to vehicle weight, vehicle weight relative to capacity, or the number of deliveries that company or that particular vehicle has made to a certain area within a given amount of time. Such solutions, however, would almost certainly require the use of intelligent transportation systems (see next section).

Urban design responses — Infrastructure.

Modifying the urban infrastructure is another means by which to address e-commerce-induced changes to passenger and freight transportation systems. Unlike regulatory responses, however, infrastructure responses are more flexible, in that they do not, necessarily, simply attempt to control congestion but instead try to adapt the urban landscape to accommodate new physical and systemic patterns of transportation.

Intelligent transportation systems do address congestion. Essentially the application of information technologies to the transportation system — vehicles, infrastructure, support and logistics systems, monitoring and management centers — ITS methods could be used, for instance, to implement a road-pricing scheme such as those described in the previous section. Improved ITS devices and coordination could help cities accommodate far more cars far more efficiently — perhaps through assisted or automatic vehicle navigation — thus eliminating many of the concerns about e-commerce-induced congestion increases. (DOT, Downs)

Also, ITS has the advantage of being currently in vogue in the United States. 1998's Transportation Equity Act for the 21st Century mandated that all transportation projects in the United States that receive federal funding — the majority — utilize a National ITS Architecture and set of national ITS standards currently being constructed by the U.S. Department of Transportation. (DOT)

ITS technologies do have tremendous potential to help manage the transportation impacts of e-commerce. But ITS is extremely expensive, the technologies involved are immature and not yet proven in real-world applications, and compilation of the requisite national standards is subject to intense political lobbying. In the long run, ITS may be a significant part of the solution, but its short-term influence will be minimal. (DOT, TTI)

Infrastructure modifications. What about adding new lanes, new loading and unloading zones, and other facilities to accommodate the increasing number of delivery vehicles plying American streets? It might be possible to adapt the crowded urban streetscape to ensure that a continued e-commerce-induced growth in point-to-point freight deliveries does not make streets impassable. Such infrastructure modifications would probably pair well with well-thought-out regulatory measures. As of the time of this writing, no such infrastructure modifications, whether paired with new policies or not, are known to exist on a concerted, metropolitan-wide level.

Architecture modifications. It might be possible in urban areas to refit some structures — not just the infrastructure but individual buildings themselves — to accommodate more frequent, e-commerce-style freight deliveries. New loading and unloading docks and areas can be constructed; existing loading docks can be retrofitted to service not dedicated, fully-loaded tractor-trailers, but half-empty, third-party delivery vans that, instead of lingering at the loading platform, depart as soon as the intended packages are handed over.

Residences might consider a retrofit as well, to accommodate increased delivery of goods. It is not a given that someone who orders e-commerce goods will simply sit at home waiting for them to be delivered; some secure means of leaving delivered goods for an absent customer may need to be devised. The doorstep, porch and curb are certainly inadequate to the task.

Houses may soon need some sort of super-large locking mailbox to accommodate deliveries — perhaps a loading dock. In addition, what happens when households order perishable goods like groceries? Present-day home grocery delivery services, like HomeRuns, oblige their customers to agree to stay home during a “delivery window” one or more hours in length in order to receive their groceries. (HomeRuns) Surely firms will soon compete to see who can offer the

valuable convenience of asynchronous grocery deliveries, so that the customer doesn't have to be home to receive his food. But important questions are thus raised. Is a secure storage area available outside the customer's house to deposit perishable goods? Milk can't just be left on the curb. Will the customer have to permit the deliveryman to have access to the house itself? Or will there be a desire to allow deliverymen access to a garage, or some other secure, semi-private area, that permits safe delivery of goods but does not impinge upon customers' privacy?

New infrastructures. Mass transit systems were developed in urban areas in the late 19th century as a response to severe passenger congestion. Is it not possible that new mass freight transportation systems will be created if e-commerce-induced freight congestion reaches extreme levels? Individual buildings, and in some cases clusters of buildings, have already experimented with such devices as pneumatic mail chutes, conveyor belts, dumbwaiters, and the like. If e-commerce creates enough of a demand for new forms of urban rapid freight transit, history suggests that new physical delivery methods may be one result.

Urban design responses — Paradigm.

Managing congestion — including anticipated e-commerce-induced freight traffic — through policy and infrastructure responses is, in some respects, a conventional approach. A growing trend is the more unconventional approach taken by an increasing number of cities and states nationwide — shifting the dominant consumer paradigm in favor of e-commerce. This paradigm shift, what e-commerce proponents have long had in mind, has further implications for passenger and freight transportation.

Debates rage about Internet taxation and the potential drawbacks to e-commerce. But in its own way, government is, for the most part, an e-commerce booster. Government services are being put online at an incredible rate — not just information, but actual transaction opportunities, or “e-government,” if you will.

Officially, it seems that governments are simply trying to take advantage of modern technologies to provide better service to citizens. But by eliminating the need to drive downtown to visit an agency office to take care of something, government is accelerating the paradigm shift e-commerce has had a large hand in starting. This shift, long urged by trendy magazines like *Wired* and *Fast Company*, looks set to continue, especially with the informal government imprimatur that seems to have been granted. The impact on transportation depends on the speed and extent of the paradigm shift.

Companies are also encouraging a paradigm shift through the use of telecommutation, which is thought to reduce overhead costs and increase employee flexibility and satisfaction. (Hows) As noted previously, telecommuting has not yet had a noticeable impact on passenger transportation. But partly because of e-commerce, more companies are making a conscious effort to ‘dematerialize,’ to use telecommuting to actively move toward the new spaceless paradigm. It is unclear

what sort of feedback relationship exists between e-commerce and telecommutation, and likewise unclear what the effects of this radical paradigm shift will be on transportation over time.

Nonetheless, consumer acceptance of the paradigm shift, thanks to the efforts of companies and government, to the phenomena of e-commerce and telecommutation, is growing. Perhaps the next step, if transportation congestion is still to be avoided, is encouraging new uses of the time that e-commerce and telecommuting make available — if, in fact, they do free up time. (Hows)

Other Concerns.

E-commerce and its consequent transportation impacts raise a goodly number of other questions. These are too numerous and each too detailed to discuss at length, but some of the most important concerns are here listed.

As noted previously, e-commerce is just getting off the ground — that is one of the reasons its impacts on transportation are hard to quantify and harder to predict. Just as difficult is predicting the evolution of e-commerce itself. What new e-commerce trends will crop up in years to come, and what transportation impacts will *those* have? One such example is a new service called Kozmo — they will deliver books, CDs and other convenience items to your door in under an hour. (Kozmo) Is this representative of a new trend? How will same-day delivery revolutionize the transportation system? And what will the effects be of phenomena not presently imaginable?

What about trends in passenger and freight transportation that are independent of e-commerce? Will transportation trends somehow influence e-commerce, with an additional resulting effect on transportation? For instance, if people begin using e-commerce tools to purchase travel goods and services in order to support a lifestyle that is characterized by a large amount of personal travel, how will personal travel thus be affected? There is also the matter of new transportation technologies — everything from fuel-cell-powered ‘clean cars’ to the proposed Airbus A3XX megajet. Cause and effect relationships become quite murky indeed.

This is true also with respect to urban design. Are we progressing toward electronic cottages or a Bill Mitchell-style “e-topia”? (Graham, Mitchell-B, Mitchell-E) Is the design orthodoxy of the New Urbanism movement gaining acceptance among practicing urban planners? If more walkable neighborhoods are created in the coming few years — as is the intention of thousands of planners,

walkable-city advocates, and Vice President Al Gore — how will that factor into the relationship between e-commerce and transportation? Is e-commerce compatible with New Urbanist cities and towns? Whether it is or not, how will e-commerce combine with new urban design practices to influence transportation?

The importance of changing institutional and regulatory approaches to transportation cannot be overstated. Much as the late twentieth century saw a shift in policy toward telecommunications infrastructure in service — from public ownership and operation to private (Graham) — the transportation industry is currently experiencing a great deal of regulatory and ideological upheaval. Is transportation a commodity or a public good? Should drivers be obliged to directly pay the cost of the negative externalities of road use in proper proportion with their individual use? That is, should drivers pay the full cost of driving every time they drive, in the form of tolls or a gasoline tax, as opposed to continuing the current tax-subsidized form of roads payment? Should transit systems be privately or publicly owned and operated? How should private freight transport be regulated? What is the future of the United States Postal Service?

Socio-cultural concerns are similarly weighty and even graver. Will negative transportation impacts of e-commerce be felt disproportionately by minority groups, or those with inferior access to transportation alternatives, or by the elderly or disabled? How will e-commerce's reshaping of passenger and freight transportation affect the social order? Equity issues, as always, loom large, perhaps particularly large with respect to e-commerce, which is often portrayed as a great, democratizing technology. The U.S. Department of Transportation has long been sensitive to the needs and concerns of those under-served by existing transportation alternatives, to the point of creating regulations specifically aimed at mitigating the negative effects of transportation on disadvantaged groups.

Conclusions.

E-commerce's impacts on passenger and freight transportation are not absolutely clear. Some facts are, however, incontrovertible:

E-commerce is a significant, growing phenomenon. As more households purchase computers and surf the Internet, e-commerce will undoubtedly continue to grow by leaps and bounds, particularly as vendors become even more competitive.

The impacts of e-commerce on transportation are largely being ignored. The press is concentrating on the "front end" of e-commerce — the consumer experience — and not the actual mechanisms in passenger and freight transportation that are e-commerce's enablers.

E-commerce is impacting freight transportation. The shipping industry is hot, as firms like Federal Express and UPS deliver tens of millions of packages daily and expand their truck and airplane delivery fleets. Delivery methods are changing; expanded, more frequent deliveries mean that trucks are beginning to contribute significantly to urban congestion.

Passenger transportation has the potential to change as a result of e-commerce. E-commerce may cause the generation of more or fewer trips, whether for shopping purposes or not; that is yet unclear. But the longstanding twentieth-century trend — increasing automobility and increasing congestion — may yet be undone by e-commerce.

Urban design responses to e-commerce will affect freight and passenger transportation. Policy responses may regulate freight deliveries; infrastructure responses may actually alter the urban landscape; a paradigm shift in favor of e-commerce (and telecommutation), currently being encouraged by many companies and government agencies, has the potential to reshape everyday life.

New trends — both in e-commerce and in transportation — are hard to

predict; their interrelations are even harder to predict. As one example of the confusing cause-and-effect relationships between e-commerce and transportation, consider the example of overnight delivery. Federal Express was able to inaugurate overnight delivery in 1973 thanks to improved jet transportation, modernized management, logistics, and supply-chain techniques, and the availability of state-of-the-art computer technology for inventory, tracking, and processing. (Yahoo-F) We now have a situation where delivery methods, trends, and technologies are all evolving simultaneously. Same-day delivery, for instance, is now technologically possible. What happens when new trends and technologies that cannot yet be predicted arrive on the scene?

Cultural considerations may play an important role. New preferences in urban design and concerns about socioeconomic equity are more visible than in recent history, and policymakers and entrepreneurs alike are taking notice.

The safest statement that can be made at present, therefore, is that e-commerce is definitely changing transportation in the United States, freight more visibly so than passenger. Although the exact nature of these changes is not yet fully understood, it is important to begin considering responses to them, as well as the cultural environment in which they are taking place. Planners and policymakers should also note the extremely fast-moving nature of both e-commerce and transportation, and should therefore realize that so-called “solutions” to e-commerce’s transportation impacts are likely to be neither comprehensive nor permanent.

It is possible to envision very different futures, depending on the attitude one takes toward e-commerce’s transportation impacts. Three such perspectives are here presented, as a means by which to better understand the various alternatives.

Three Possible Futures.

The following descriptions are predicated on the transportation impacts of e-commerce that would be anticipated from each of the listed perspectives — deterministic, utopian, and dystopian. Interestingly, note that the labels ‘utopian’ and ‘dystopian’ can probably be interchanged with their descriptions; one person’s ‘utopia’ is another’s ‘dystopia.’ (This is better described below.)

Deterministic.

As defined in Graham, technological determinists “see the relationships between telecommunications unproblematically as a relatively simple and linear set of technological causes and urban effects or impacts.” This paper, by that definition, would seem to be written from a deterministic perspective — the title “Transportation Impacts of E-Commerce” itself provides some substantiation to that viewpoint — although that is not the intention. (In fact, I have attempted to be determinedly neutral in my assessment, and have, among other things, pointed out that cause and effect cannot be easily differentiated.)

Determinists, though, would take a much more concrete view, quite literally viewing e-commerce as a technology that does in fact have discrete ‘impacts’ upon the urban landscape. E-commerce, as well as telecommutation and intelligent transportation systems, will force the evolution of passenger and freight transportation; cities will adapt to accommodate them.

Much as previous chapters in history were marked by adaptation to new delivery techniques and methods, so too would the beginning of the twenty-first century be characterized by an increased evolution of the urban infrastructure, and of planning and policy, toward a new e-commerce paradigm. Just as cities incorporated physical and regulatory changes in response to the streetcar, the subway, and the automobile, so too will they adapt to include new facilities for e-

commerce-induced freight deliveries.

Policy shifts will mirror societal acceptance of e-commerce and will make possible the continued functioning of our transportation systems in an era of e-commerce. Infrastructure shifts will permit the level of freight deliveries demanded by an e-commerce-empowered populace. And the transportation paradigm will change as necessary, in order that some kind of operational equilibrium is struck between old and new. Techniques such as road pricing and technologies such as intelligent transportation systems will have their inevitable place, depending on what is necessary to keep vehicles moving.

Interestingly, only some elements of technological determinism are currently present in popular coverage and opinions regarding e-commerce. Specifically, observers are noting that although e-commerce is already causing changes to be manifested throughout society, few have connected e-commerce with changes in transportation. If anything, more attention has been focused on passenger than freight transportation, even though changes in freight transportation are at the moment far more comprehensive and probably much easier to consider conceptually. Nonetheless, it is probably just a function of our solipsistic genetic programming that people seem far more interested in how e-commerce will change how *they*, not their books and CDs, will get around.

Utopian.

Bill Mitchell, Alvin Toffler, and many other prominent public figures have adopted a utopian perspective with regard to e-commerce and transportation. The general utopian premise is that passenger transportation will no longer become necessary for shopping trips, and e-commerce combined with telecommutation will make all personal travel a luxury.

Most of the utopians conveniently ignore the matter of freight

transportation. That is because the utopian viewpoint tends to “black-box” those processes of e-commerce transactions not immediately visible to the consumer; everything that happens after the “purchase” box is clicked is conveniently invisible — out of sight and likewise out of mind. This is unfortunate; it is the primary reason why utopians are unable to construct a credible model of an e-commerce paradise.

Certainly there are potential utopian outcomes as concerns e-commerce and transportation. The passenger transportation model is far easier to comprehend; if the utopians have it their way, shopping trips will indeed become an indulgence. The matter of freight is somewhat more difficult to conceptualize in a utopian fashion. Probably, however, utopian freight delivery would have to reconcile a number of currently contradictory elements. Logistics systems, supply-chain management, and delivery fleet distribution and capacity would all be integrated far more closely and efficiently, thus resulting in a freight delivery system that permitted complete utilization of delivery capacity *and* just-in-time deliveries on an unpredictable, immediate basis.

That reconciling such a contradiction seems unlikely would not bother a utopian, presuming a utopian could be bothered to think about freight in the first place. It is perhaps understandable that no self-conscious utopians have publicly put forth visions of a green future paradise that include brown UPS trucks rumbling down the street. Nonetheless, an e-commerce utopia is predicated on there not being any transportation problems whatsoever, whether with passengers or with freight, and for that to happen certainly some means of freight delivery must be preserved. In a longer-term view, utopians might gravitate toward considering new delivery technologies that do not involve environmentally destructive ground vehicles in the first place.

Utopians often place great emphasis on improved automobile technologies,

such as automatic global-positioning-system location devices, auto-navigation and other ITS technologies, and complete access to the office and the Internet from the driver's seat. (Sheffi) Many utopian visions call for such techno-cars to supplement telecommuting; if trucks were also so equipped, traffic congestion would consequently be a thing of the past.

Dystopian.

If a 'utopian' vision of e-commerce includes consumers sitting comfortably at home awaiting delivery of goods — or out enjoying themselves in fully wired automobiles while van drivers unload their purchases into secure storage sheds next to the garage — it is only a slight variation to take the same view and label it 'dystopian.' For there are two potential dystopias, the first of which finds horror in that which utopians would aspire to — remote delivery of goods and services using e-commerce.

There are those who value traveling themselves in order to accomplish something; these people would despair at their shopping trips being replaced with delivery of their purchases. Many enjoy the trip to the supermarket simply as a social experience; consumers often cite such enjoyment as a reason for avoiding e-commerce grocery delivery services like HomeRuns. Travel and socializing are closely linked.

Travel is also closely related to the sense of purpose, of 'mission.' As an example, take college libraries. Students now have access to precisely the same reference materials in their dorm rooms, and study areas as quiet as those in the libraries are available in common spaces and lounges. Why, then, do students still travel to libraries in droves to study? Because of the sense that their actual travel is a journey, that they are accomplishing something merely by going somewhere else to study. Dystopians would claim that all of us would lose if we were deprived of

that experience.

The other, more common dystopia is simply that the national transportation infrastructure would be unable to accommodate the projected increase in freight transport, and gridlock and environmental catastrophe would result. Commercial transactions would become much more expensive, personal transportation would become a production of epic proportions, and society would suffer correspondingly. Dystopians of this type are, at best, extremely skeptical of technologies such as ITS, which utopians herald as the answer to many of dystopians' worst fears.

In point of fact, there are other dystopias. The idea that e-commerce could generate additional passenger trips in addition to more freight deliveries is another factor that could aggravate smoke-enshrouded urban gridlock. Also, there have been concerns expressed about the socioeconomic disparity of e-commerce technologies, gloomy forecasts that the worst predictions about cultural and social stratification will come true.

Naturally, these perspectives are conjectural, based on the attitudes determinists, utopians, and dystopians have been said to have. (Graham) As additional information and more detailed statistics about e-commerce's impacts on transportation become available, it will be possible to better classify the various viewpoints.

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