GENERAL CHARACTERISTICS OF CORPS WATERWAY MODELS

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Generic characteristics: what do we really do when modeling inland navigation? It is difficult to discuss how the models function without considering the data issues.

- Waterway traffic O-D trips are the starting point for all evaluations of what is on the waterway. This is in the waterborne commerce data. Not ultimate origin to final destination, but waterway movements.
- First we need to understand what is meant by an "individual waterway movement". An individual waterway movement is from one waterway dock to another waterway dock.
- There is some amount of aggregation when we talk about movements but we start with individual barge movements. The standard way to generate these movements is to aggregate from a specific commodity to an annual flow.
- Once the waterway traffic has been identified, we then start examining alternative modes, specifically water, rail, and pipeline)
- Which modes are realistic to consider depends on the specific movements.
- It is critical to remember that these discussions deal with SAME ORIGIN and SAME DESTINATION when shifting modes.
- With or without the project can and do allow for different types of changes in the flow of traffic but not in a dynamic sense. It is fixed at whatever we decide is the most appropriate way to represent it. The framework is, in a general sense, a least cost framework- whatever the next best least cost alternative mode to compare.
- These are not multiple modal analyses. We look at other modes for comparison, but not for the ability of the alternative mode to move the traffic. We are not forecasting the total volume of traffic moving on the alternate mode, consideration is not given to how the shift will impact the modes ability to accommodate the different traffic levels.
- Should we expand the scope of what we examine? We could consider emissions and landside congestion consequences. The study that TVA is involved in is one example of examining externalities to a greater extent, but it is one of few.
- Rates and costs for O-D-C triplicates are estimated for ultimate origin and final destination. In the analyses we try to use rates but if they are not available constructed costs are used instead.
- Existing models deal with constructed costs, they deal with issues of on water or not and backhaul percentages.
- Costing is the default method when we are unable to determine actual rates.
- Delay costs are expressed per unit of time on either the commodity level or on the movement specific level. They are expressed as a $/ton/hr or per movement
- Traffic and the average delay relationship is a significant piece that goes into inland modeling.
- If the level of modeling is annual traffic then curves will be annual, including the effects that result from service outages (scheduled, unscheduled, and major rehabilitation) and an expression of the without project condition.

- If there is a single unifying concept of P&G, describing how to do any benefit analysis of any kind, it is that any evaluation should be based on WTP.
- How to represent WTP in a model takes on high significance. The issue of what is a movement becomes important here. When expressing an individual movement, the demand for waterway services is represented as being perfectly inelastic.
- We then build a waterway aggregate demand curve from the series of inelastic movements. This aggregate demand curve becomes a stair step function.
- A consequence of representing demand this way comes when finding equilibrium solutions. At the margin we are identifying the marginal movement as opposed to the marginal ton that may exist in a marginal movement.
- The WTP to be on the waterway for any movement is something that can be done directly. This underlies the calculations of any models.
- Traffic forecasts are done in a variety of ways, but all are saddled with the 50-year projection.
- Forecasts are done for an unconstrained waterway. They are mostly used to answer the question: "What are the expected volumes on the waterway assuming that there is no change in the current price of waterway transportation?"
- The specific guidance from the P&G regarding alternative modes states "alternative modes have sufficient capacity to move traffic at current rates unless there is specific evidence to the contrary."
- As a note on system modeling, we are beyond the notion of doing analysis and limiting it to one site, we are always doing some sort of system analysis and not just examining consequences at the one site of improvement.
- While we do system analysis, we do not necessarily do *system studies*- we consider what will happen elsewhere but really only consider improvements at the one site.
- An example of a few projects being considered now that deal with systematic studies, is The Upper Mississippi and the Ohio River Mainstem System Study. These studies do not focus on one location but try to look at entire network and see what makes sense to build throughout the system. These are efficiency improvements.
- When considering a system study it is difficult to determine where to draw the system boundaries for modeling. Currently we try to explicitly model the nearby locks in the system. We try to consider the entire inland system in the studies, but the extent to which that happens is relative to each specific study. There must be a trade off within the level of complexity that one is willing to undertake in a study.
- Models generate optimal shipper solutions. Any movement that has a positive rate of savings for the given level of traffic will continue to be on the waterway until it reaches the point where the cost of being on the waterway erodes the WTP to be on the waterway. Until that point the tonnage will be in the benefit equation.
- Transportation cost savings is the key for benefits.

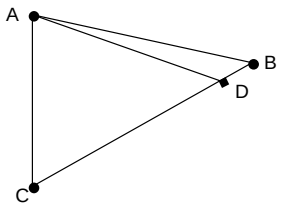
Discussion:

- Within the framework we are pursuing, we are doing a reasonable job with tools, techniques and know-how for costing. For the case where we expand the requirements of the analysis we may need to look at costing in a different context. In some sense there is a consistency in technique. The challenge is in digging out the

landside component of the movements, figuring out what the actual landside points are and the associated costs.

- In estimating landside costs, making general assumptions can be misleading. Costs can differ from just the price for moving the commodities. Rail service may be costly in that service is poor and shippers have to have twice as many rail cars (inventory) on hand to accommodate their tonnage. Other similar conditions may exist but are just using traditional assumptions. Need to do research to find out what specifically differentiates the various modes.
- There can be a supply chain that impacts customer transportation route choices. COE does handling but does not do accident risk or freight reliability analysis. This is a difference between rate costs and WTP. We do not have the exact right framework to get at WTP.
- Each shipper has different reasons for going to the water, cheaper transportation is just one piece. There are many reasons for traveling by rail that support the historic inelastic assumptions. If a shipper is on the end of the line they will only get rail service once per week, resulting in an absolute WTP for barge service to make up for the poor rail service.
- Guidance is clear on WTP. It gives options for measuring WTP. First, use the observable market prices to measure incremental units of output. How do we answer the marginal question; e.g. say we have one shipper moving 1M tons on the waterway for $8/ton. Purchasing waterway transportation at the observed price and not using the alternative method is the shipper's choice. If the cost of the alternative mode is $20/ton then what the models are saying is the shipper's WTP is the $20/ton. Yet the observable market price is $8/ton.
- The 1,000,000-th ton, the marginal ton, is likely equal to the marginal cost. If the shipper is paying $8/ton then the last ton is worth his marginal cost of $8/ton.
- The marginal decision making of the firm is done with respect to profits and not to minimizing his transportation costs. The profit maximizing decision is driven by the net price that the shipper is going to get for the 1M ton. When sizing the plant or choosing output he made the decision to stop at 1M. When making this decision he took into consideration the marginal cost.
- COE is directed to look at the long run considerations. The marginal cost as the market price for the marginal commodity.
- If there is a delay in the lock system then the perceived cost to the shipper may increases from $8 to $15/ton. The shipper will then reduce the volume produced. If the congestion is decreased then the perceived price will fall below $8 and volume will increase.
- There are rumors that econometric studies have been done on data with delay times.
- The O-D-C combination is essentially the marginal movement we are considering. We should not consider O-D-C as the marginal movement. We need to get it down more specific; we need to consider the marginal ton.
- Suppose an alternate movement requires removal from the dock by truck then rail to someplace so that it can ultimately move back to the water. If considering the ultimate origin to final destination, the cost may have a couple of landside components to it. If we calculate the cost of taking it back again to complete the route, then could you overestimate the willing to pay?

    - When considering alternate modes we assume that the transactions will have the same inland origin. The most efficient alternative route from that origin is calculated.
- Right angle demand curves are okay if everything is aggregated low enough, under those circumstances one can really get the reservation price for everyone. Right angle curves include the idea of the stair step function when a shipper has alternate destinations.
- The way we are measuring savings from ultimate Origin to final Destination is to rank the movements by savings and then say the movement with the lowest savings is the marginal movement. Marginal movements will get bumped off when the cost of the waterway increases.
- Within the marginal movement there might be marginal tonnage. It is a question of what level do we look at the margin? Is it the complete marginal movement or the marginal tonnage within that movement? The easier solution is to look at movements.
- WTP or willingness to endure a delay drives the equilibrium level of tonnage in the without project condition. Measurement of project benefits is the delta in transportation costs. WTP is important because that dictates who will be on the waterway.
- If the price for waterway transportation is $8/ton then the marginal value of an incremental change is also $8/ton. This has to hold market wide if it is a well functioning market
- There exists a disconnect between the theory and what we find in the real world. In actual practice there are stranded and committed assets. Many non-smooth cost and demand functions exist in the real world.
- How do the conflicts between theory and reality impact WTP?
- All we can observe are short run outcomes but we need to model long run outcomes.
- O-D issues are separate from the task of computing the delays.
- When dock data is rolled up into a larger summary it can become a big source of bias.
- In these studies there is a need to emphasize all of the alternatives that are available to decision makers. If a shipper wants to ship a commodity from A to B (figure below) but there is a delay on that route. As an alternative the shipper could take a landside route that goes from A→C→B. This would be very costly. Another alternative would be for the shipper to instead ship to a location near B, such as D. This changes the final destination but may result in a very small change in cost.



- O-D-C information is developed when specific studies arise but there is no standard database with a collection of all of the information that has been collected for each study.
- One study examined trucking congestion resulting from a lock closure that caused traffic to be routed around St. Louis. This study found large storage facilities, ethanol plants and feed lots. Any of which are options for the shipper. The study also needed to examine externalities because rail service to the river (around St. Louis) was not available. Trucking around St. Louis would add to St. Louis's out of compliance for ozone problem.
- People have studied these problems. How large will the shipment be given the mode taken? They have found that the mode will dictate the size of load. It is incorrect to assume the quantity shipped will be constant. You shouldn't assume fixed quantities because sometimes the quantities will change by mode of shipment.
- Shipment sizes could be endogenously set. Are they dependent on the market?
- Haven't talked much about forecasting issues. There are short run and long run complications. There are a lot of different "runs" to think about. Forecasting the future is difficult; how is it possible to determine if someone will rebuild the plant in the same place after it runs down? Building a factory results in mode specific sunk costs. These may lock the shipper into the specific mode. The WTP to avoid the delay incremental cost is the absolute cost the shipper is willing to pay to avoid the delay.