

GRAIN AND SOYBEAN INDUSTRY DYNAMICS AND RAIL SERVICE

Analytical Models of Rail Service Operations

BACKGROUND

To remain globally competitive, the United States' grain industry and associated transportation services underwent significant restructuring over the past fifteen years. New technologies, helped by weather changes, led to sustained yield volume increases in the Upper Midwest. To move larger volumes faster and at lower cost, the railroad industry introduced shuttle train service. Traveling as a unit to the same destination, shuttle trains save considerable time in transit and potential delay, bypassing intermediate classification yards. Grain shippers concurrently began consolidating and storing grain in larger, more efficient terminal elevators (shuttle loaders) instead of country elevators. Using simple conceptual and analytical models, this study examined why shuttle trains are effective relative to conventional rail service, while considering their impact on grain consolidation at storage elevators and the trucking of grain to storage elevators.

METHODOLOGY

Three analytical models were developed to compare shuttle train service with conventional rail service; these are:

1. A *time model* to determine the time it takes to transport grain from the farm to a destination (e.g. an export elevator).
2. An *engineering cost model* to estimate the aggregate variable costs of transporting grain from the farm to the export elevator.
3. A *capacity model* to evaluate the maximum attainable capacity (throughput) of a rail network as a function of demand for rail transport and the respective percentages of railcars on the network moved via shuttle vs. conventional service.

Figure 1 illustrates the grain supply chain modelled in this study.

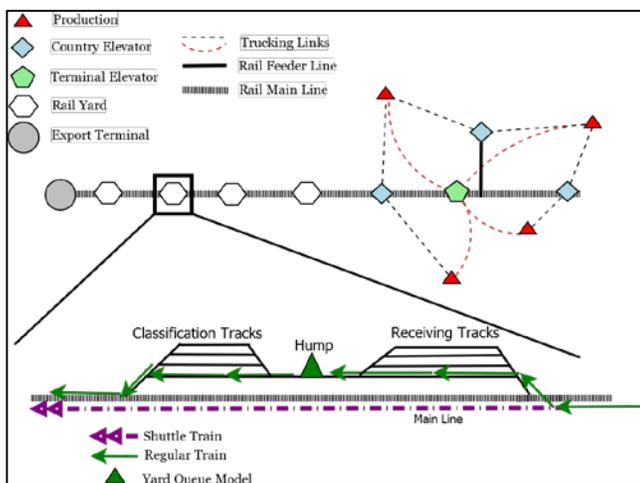


Figure 1: Grain Transportation Network Abstraction

SUMMARY OF RESULTS

Time Model Results

- Shuttle train service is significantly faster at moving grain than conventional service. This time includes trucking, unloading trucks, short-term grain elevator storage, and loading railcars, along with the rail transport time.
- The ability of shuttle trains to bypass classification yards provides a significant travel time advantage.
- Grains may spend a longer time in storage under shuttle service to consolidate enough grain to fill an entire shuttle train order. This difference decreases considerably at higher demand levels.

Cost Model Results

- Shuttle train service has higher trucking costs and elevator storage costs than conventional rail service.
- Shuttle service reduces labor costs by bypassing classification yards and always traveling in units of 90-120 railcars. Additionally, shuttle service reduces in-transit inventory costs because it transports grain faster over the rail network.
- Altogether, shuttle service can lower grain per unit transport costs substantially relative to conventional rail (by around 15%).

Capacity/Throughput Model Results

- At moderate network congestion levels, assigning railcars to shuttle service reduces the demand pressure at classification yards as they don't become bottlenecks that restrict network throughput.
- At high congestion levels, assigning railcars to shuttle service can prevent conventional railcars from blocking the mainline rail network.

CONCLUSION

The time, cost, and capacity models presented in this report allow for a comprehensive comparison of shuttle train and conventional rail service. The entire grain supply chain from farm to export elevator is analyzed. The results indicate that shuttle train service has considerable advantages over conventional rail service across all three rail service dimensions considered. The ability of shuttle trains to bypass classification yards provides an enormous operational and cost advantage over conventional service. The advantages of the shuttle train system benefit railroads, grain shippers and grain producers. Shorter travel times allow grain shippers and producers to get their products to market faster and allow railroads to increase the utilization of their assets. Increased throughput lowers unit transportation costs and allows grain shippers and producers to be more responsive to market demand. The increased throughput due to shuttle service allows railroads to increase revenue without the massive capital investment typically required to increase rail network throughput and revenue.