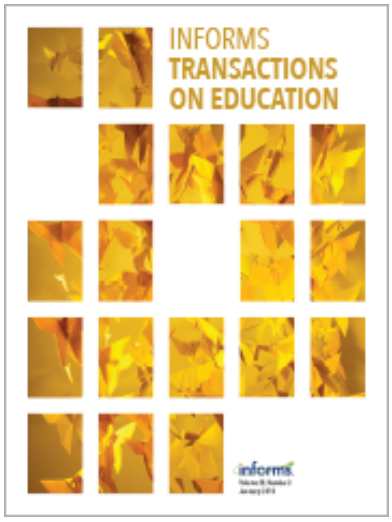

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Case

Integrative Case Study: Louisiana Branch Lines

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Louisiana Branch Lines

Lawrence Byron Lassiter owns a small railroad, Louisiana Branch Lines (LBL), which operates in the Southeast United States. Mr. Lassiter needs analytical support on the serious performance problems he is facing. The problem seems to span many facets of the organization—finance, marketing, and operations. Mr. Lassiter has called a meeting of his leadership team from each organization to try to get some resolution to these issues. He asks the director of his new data analytics group, Donna Andriesen, to provide some independent insights and ideas for how to resolve some of their issues. LBL faces a host of problems, which are outlined below.

Donna has, in turn, called you in for help. As part of your introduction to LBL, Donna sends you this background on the U.S. freight rail industry.

Freight Rail Background

Freight rail service provides movement of freight. The *product or service* that railroads sell is transportation from an origin to a destination (often described as an "OD" or a "lane").

In the United States, freight railroads move almost one half the tonnage moved from origin to destination. Freight rail moves coal, grain, lumber, consumer goods, chemicals, and automobiles. Its fastest-growing segment is moving truck containers on trains; as a substituted for truck, trains move just about anything.

In many lines of rail business in freight rail, such as boxcar shipments, the railroads own the railcars. In these lines of business, Louisiana Branch Lines, as most railroads, must deliver an empty railcar, at its expense, to a shipper for loading before the shipper can ship its load for revenue. This empty car delivery is often called "equipment distribution."

There is an interaction between marketing, which sells the loaded movements; operations, which moves empty equipment; and finance, which provides the assets to support the service. Each role is described below.

Marketing and Pricing

As with any product, there is some general level of *demand* (also known as load volume, units, or loads) for an OD and some customer sensitivity or elasticity to pricing; as price goes up, the quantity demanded goes down, and vice versa.

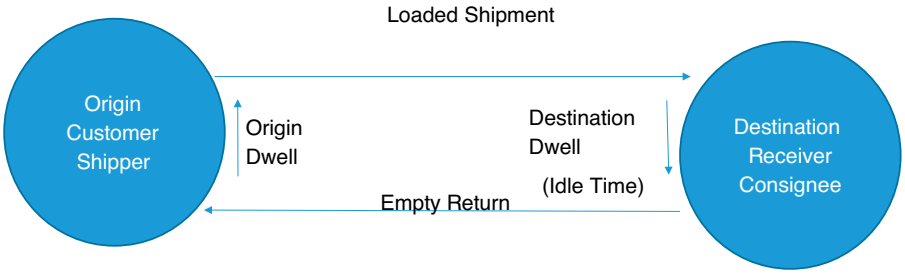
The *supply* or capacity to provide this service is based on a host of factors, including crews, locomotives, rail yards, and rail lines. However, the element of capacity most directly attributable to providing service in a lane is the supply of railcars at the origin. Often prices are high in high-volume ("head haul") lanes whose origins are generally deficit empty equipment and lower in low-volume ("back haul") lanes, where the origin has a surplus of empty equipment.

Marketing generally sets pricing goals or targets to achieve a mix of margin, margin percent, revenue, and volume objectives. Sales people are often organized by the shipper's origin and/or geographic region to build strong customer relationships and expert knowledge of a region's shippers.

Operations: Empty Car Management and the Equipment Cycle

The "equipment cycle" follows a railcar through its cycle between empty and loaded status. At its simplest,

Figure 1. The Equipment Cycle (Illustrated with 100% Empty Return to Origin)



empty cars can be "reverse routed' from destination back to the origin for reloading. The loaded component of the cycle includes origin dwell (customer load), loaded shipment (moving railcars on railroad), and destination dwell (receiver unload). The equipment distribution group tries to allocate cars more efficiently, finding nearby origins for pairing with load destinations.

As depicted in Figure 1, the detail of the equipment cycle is as follows.

- *Car order:* The customer, or shipper, places orders an empty railcar in anticipation of making a shipment (known as a car order).
- *Empty distribution:* An empty car is retrieved from somewhere in the rail network and delivered to the customer via the train transportation network.
- *Origin dwell:* The empty car dwells at the shipper for some time for loading (shipper or origin dwell).
- *Loaded shipment:* Once loaded, the railcar is sent from the origin shipper over some miles over some duration to the destination receiver (or consignee).
- *Destination dwell:* The car dwells at the receiver location for unloading (destination, or receiver dwell). At the time the receiver "releases" the car, the railroad is able to retrieve it for use in another order.
- *Idle time:* The empty car is picked up from the destination location; until it is allocated to a shipper for loading and the cycle begins again, the car is in empty idle time. Once the car is allocated to an order, the cycle repeats again.

In the short-term (over days or weeks), equipment distributors must allocate empties to orders as the orders are received. This means choosing, among available empties, which empty to apply to which order. This is a dynamic and quickly changing environment, as orders are received and cars released on a continuous basis throughout the day. (See Gorman et al. 2010 for a detailed description.)

In the longer-term (over months or quarters), "structural imbalances" result from the difference in lane volumes, with chronic deficits and surpluses in many geographic regions. In many freight transportation networks, the number of loads out of a geographic region often does not equal the number of loads. This creates an "equipment imbalance" of either a deficit (more loads out than in) or surplus (more loads in than out). The short-term and the long-term are not separate problems but rather the same problem on varying time horizons. Structural imbalances may cause longer idle time in anticipation of eventual car orders. A surplus of cars is expensive to reposition to where they are needed; a manager may wait in hopes they can be used rather than move them to where they are needed to avoid the repositioning cost.

In either case, the empty time and empty miles during the cycle spent in equipment distribution are expensive to railroads; the miles traveled cost fuel and depreciation of cars and track. The empty car movements take time and take space on trains, reducing capacity for loaded revenues. Finally, empty cars take space in railyards, causing congestion.

Equipment distribution attempts to reduce the cost of allocating empties to orders in the short-term and, in the longer-term, moves empties en masse from surplus locations to deficit locations to balance structural imbalances in the network.

Finance

As it relates to railcars, finance's role is to provide an appropriate number of railcars to support the business: too many, and railcars sit idle and provide no return on investment; too few, and sales and customer service fall either through unfilled or delayed car order fulfillment. Also associated with this asset procurement is an estimate of the risk related to varying market fluctuations from external events, pricing practices, and equipment distribution effectiveness.

There are a number of issues in each of these areas in LBL. They will be discussed in turn.

Marketing

- Carleen Meketon, chief marketing officer (CMO), reports that customers complain that equipment orders are not met quickly—many empties are delivered late and, in some cases, orders are cancelled because of lateness.
- She regularly complains about car availability and the inability to raise rates because of a lack of equipment, which results in slow service.

• She suggests that her group is doing its job, pointing out that direct gross margins are sound. (Direct gross margin is simply revenue per unit less the costs associated with moving those loads.)

• Although net margins (which include additional "indirect" operating expenses such as equipment dwell and repositioning costs) are falling, she argues those expenses are outside of her ability to control, as it is a function of finance who provides equipment and operations, which controls equipment distribution

• She is somewhat challenged that sales are flat. Though some customers are hard pressed to find alternatives (because of equipment shortages in the region), sales is not bullish about increasing rates because of poor service history, especially in backhaul lanes.

Operations

• The chief operating officer (COO), Carla Opelman, refuses to expand train service in the face of rising costs; her focus is on total operating costs per load; with loads largely flat, she refuses to increase expenses.

• Edward Dowd, a relatively new director of equipment distribution, has blown empty budgets and the repositioning rate (empty/load ratio, empty miles per load) is high.

• Trains are often over capacity, which further hampers empty delivery timeliness because they can't get priority over loads, further dampening service levels.

• It is particularly frustrating to everyone involved that although there are car shortages throughout the network, car cycle times are up, whereas time under load is down.

Finance

• Charlie Finklebinder, the chief financial officer (CFO), notes that loads per car are down; though equipment availability is low, there is no financial justification for more equipment purchases.

• The only way he is willing to invest in new equipment is if (1) the equipment cycle time can fall and the company gets more loads per car day or (2) margins increase, which would justify new equipment at the existing rate of loads per car.

Integrative Case Part 0: LBL Problem Overview

As part of your first meeting preparations, Donna Andriesen has asked you to consider the following questions.

• What questions do you have for the organization's leadership team about these issues?

• How would you view this problem: long-term strategic, intermediate-term tactical, real-time operational, or perhaps a mix? Where should the focus be?

• For each group, what are the key concerns, issues, and opportunities where LBL should focus?

• What data would you request to start understanding the problem better?

• What simplifying assumptions/scoping limitations do you think would be useful to begin addressing the problem?

Prepare initial thoughts on these bullet items prior to your meeting with LBL executives.

LBL Part 1: Descriptive Statistics and Analysis

Based on your discussions with Donna Andriesen, she has provided summary data for LBL.

In order to provide you some insight into their issues, she has provided 19 quarters of historical price and volume data in each of their 12 markets and detailed data on the last quarter's costs and operating statistics.

In preparation for your next meeting, summarize LBL operations, asset utilization, and profitability with the appropriate descriptive statistics and key performance indicators.

Summarize LBL current market profitability with a number of appropriate metrics.

• What would you recommend are the most appropriate areas of focus for LBL to create operational efficiency and profitability?

LBL Part 2: Demand Analysis

Your team is working with Carleen Meketon, the chief marketing officer, who is looking for ways to improve margins and service. She has historical data on market volumes and prices (provided). Each quarter, her team usually begins with the average historical price and adds their insights on competitive factors on suggestions to raise or lower prices according to their insights on the competitive landscape in each lane (origin-destination pair). She has organized her team account representatives by origin lane—that is all destinations associated with a single origin (e.g., A to B, C, and D; B to A, C, and D, etc.). She figures each person can become familiar with shippers in each origin city, thereby establishing the best prices.

Carleen's primary focus for this project is the following:

• She wants to better understand/predict how customers respond to price changes in each market.

• She wants to understand the level of confidence surrounding customer price sensitivity predictions

Provide answers in report format to the following to turn in:

• Submit a report summarizing your findings on her request and your recommendations.

LBL Part 3: LBL Price Optimization

Carleen is impressed with the new found understanding of customer responsiveness. However, having that information does not necessarily give her a clear picture of how to make use of it. She is interested in getting recommendations on pricing improvements, given this information on demand.

- Develop a methodology that makes pricing recommendations given this information
- What are your decision variables? What are your constraints?
- What assumptions are required? How would you justify them?
- What risks should be noted?

Provide answers in report format to the following to turn in:

- Based on data from the most recent quarter, please provide pricing recommendations utilizing the customer sensitivity estimates.
- Submit a report summarizing your findings on her request and your recommendations.
- Are there any implications for the finance department and funding of additional cars?
- Are there any operational implications for Edward Dowd and equipment distribution?

LBL Part 4: LBL Equipment Distribution

Your team is now working with Edward Dowd, the director of equipment distribution, who is looking for ways to improve empty distribution performance. For your analysis, LBL has provided the accompanying previous quarter's data on its network. What recommendations might you make about LBL equipment distribution?

As preparation for a meeting with Edward, prepare the following for discussion:

- Prepare a summary describing current equipment imbalances with appropriate metrics.
- How would you approach the equipment distribution problem?
- Describe your approach to improving equipment distribution.
- What assumptions are required? How would you justify them?
- What data would you need to understand the issues for equipment distribution?

Please provide a report describing the following:

- Your recommended repositioning flows, given the most recent quarter's data

LBL Part 5: Pricing and Equipment Distribution

The chief executive officer, Lawrence Byron Lassiter, insists on further reducing empty time, miles, and costs. Given equipment distribution is already optimized, given loaded flows, the only alternative is to affect the loaded flows that cause the imbalance. He insists that Carleen Meketon (CMO) and Carla Opelman (COO) work together to create a collaborative and creative solution to both problems.

In preparation for the meeting with Carleen and Carla, Donna Andrieson asked you to prepare questions for them.

Please prepare a report describing your recommendations on the following:

- How would you go about changing prices in each lane in a way that creates profitable prices but reduces repositioning?
- What would you say about Carleen's organizational structure as it relates to pricing and market performance?
- Should LBL treat these pricing decisions independently of each other?

LBL Part 6: Risk Assessment

Optimal pricing solution relies on a number of assumptions and statistical estimates. Because of that uncertainty, there is a fair amount of risk associated with adopting a new pricing strategy.

LBL's CFO, Charlie Finklebinder, would like to know if the suggested pricing strategy/solution will reliably produce the anticipated results, especially with respect to the estimated customer response to price changes.

Further, because of high seasonality of demand and competitor pricing changes, he is not convinced that there won't be unanticipated surprises in shifts of the demand curves in various markets.

Please develop a reasonable way to test the recommended price changes for robustness. Develop a risk assessment of the recommended change in pricing strategy.

LBL Part 7: Optimal Pricing Under Demand Uncertainty

Donna Andriesen, the director of data analytics at LBL, raised this issue:

> We understand the profit, volume, and repositioning risk GIVEN a set of prices that were based on the assumption of certainty. But we know that those prices are not optimal, or at least have a lot of risk, because of uncertainty. We still might be "overshooting"—that is, creating surplus where there was deficit, and vice versa. We really don't even know if the solution is feasible, because with random demand and response, we only estimated repositioning costs, and we didn't recheck for feasibility. We even plugged in zeroes for predicted negative quantities, which is reasonable from a modeling perspective, but we all know that it is not very realistic.

> Since our primary decision variable is price, and optimal pricing changes with demand conditions, then shouldn't we include demand uncertainty in our optimal price finding (and, also solve for optimal repositioning in each scenario), and then have a decision that INCLUDES that uncertainty, rather than doing a risk assessment after the fact? Intuitively, since price is our decision variable, we should care most about that decision in the face of uncertainty—not ignore uncertainty until we have made a decision, then find out how much risk we are facing.

How might you design an approach that includes demand uncertainty within the optimization? In this case, it is key to understand not how the objective changes when demand changes but how the decision variable changes when demand changes.

Donna's primary focus for this analysis is as follows:

- How much does demand uncertainty affect optimal pricing?
- Can optimal pricing decisions be reliable in the face of demand uncertainty?
- What risk is faced both with the decision variables and the objectives?

LBL Part 8: Final Recommendations

Given these prior analyses, please provide summary observations capturing the overview insights of these projects.

In your summary, include the following:

- Project overview and summary, from part 0 to part 8
- Key findings from each stage of the analytical process
- What the appropriate measures of success and key performance indicators are for LBL
- Lessons learned and recommendations from each stage

Finally, and most importantly, given all of these analyses, what would you recommend to LBL as a way to effectively improve its pricing practices? What implementation strategies would you suggest as it relates to organizational structures, risks, and key performance indicators?

References

Gorman MF, Acharya D, Sellers D (2010) CSX Railway cashes in on optimization of empty equipment distribution. *Interfaces* 40(1):5–16.