Operations | Retail | Supply Chain Quality | Regression analysis

Understanding and Reducing Virtual-Physical Mismatches and Missorts in Fulfillment Centers

Amazon

BUSINESS PROBLEM

Delivery Estimate Accuracy (DEA) is the Amazon Operations metric that measures the percentage of items that attempted delivery on or before the Promised Delivery Date. There are significant costs and customer experience impacts when packages are not delivered on time, resulting in a DEA miss. Virtual-Physical Mismatch (VPM) and Missort are two major types of DEA misses that are difficult to detect and prevent. This project focuses on understanding and reducing the number of VPM and Missort misses in Fulfillment Centers, with the scope being Amazon's Traditional Non-Sort Fulfillment Centers in the US.

APPROACH

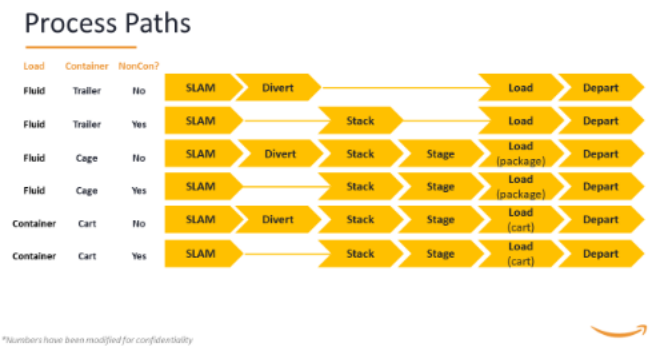
The project was conducted in 2 phases – understanding causes and exploring solutions. For causes, the current process and misses were analyzed and multiple linear regression models were built. Solutions were brainstormed with domain experts and condensed to 7 for pilots and studies. Expected costs, savings, efforts, impact, and effects on staff experience were quantified for prioritization.

DATA SOURCES

The majority of the data is based on system logs of shipment history, including package attributes, container types, timestamped scans, and planned routes. Additional data leveraged from business intelligence dashboards, such as quality defects and staffing. Some pilot data were collected via stopwatch and counting. Qualitative data were collected through 20+ stakeholder interviews.

Data Types and Format

Internal databases and clusters were accessed via Amazon's web browser-based SQL client. CSV and Excel files exported from business intelligence dashboards. Some pilot data were collected manually.



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IMPACT

A total of 7 solutions have been proposed, studied, and/or piloted on-site. These solutions vary in effort and impact, with some incurring almost no cost while others require a $84k set-up cost. Financially, the estimated total savings of these solutions is expected to be up to $1.3M per site per year. Operationally, some of the solutions will require a few extra steps within the existing process, while others (such as RFID technology) will fundamentally change the structure of the supply chain.

DRIVERS

The problems and solutions of this project were driven by the need to both improve customer experience and reduce operational costs associated with quality issues. Lost and missorted packages are common issues within both the retail and the logistics industry.

BARRIERS

Locating the appropriate data was initially challenging given the vast amount of data available within the organization. Linking and making sense of data was difficult for similar reasons. Running a controlled experiment was also near impossible since operations are always running and processes are always changing.

ENABLERS

Amazonians' willingness to help and collaborate was immensely helpful, especially in the beginning. Being in the Gemba and having access to those on the job was also helpful in understanding the actual processes, including any potential deviations from the standard procedures. The culture of documenting made large libraries of information possible, which were useful during self-studies and research.

ACTIONS

While solutions were not fully implemented, two of the solutions were piloted to estimate efforts and measure potential impact. These pilots were about 1 to 2 weeks in length. They required no change to the existing process and minimal effort from others. The results of these pilots were analyzed against the baseline to gauge its effects.

INNOVATION

The use of linear regression techniques to identify the relationship between potential factors and top causes is an innovative approach. It allowed for more quantitative evidence to support previous hypotheses from supervisors and subject matter experts. It also provided identified some insights that were surprising to internal domain experts.

IMPROVEMENT

Final improvements from the project include a better understanding of the top causes, identification of factors that contribute to these causes, and a pathway to reducing virtual-physical mismatches and missorts based on a number of short-term, medium-term, and long-term solutions.

BEST PRACTICES

Breaking the problem down into its own separate problem and solution space is helpful as design thinking allows us to truly understand the problem before solving it. Being close to the Gemba and front line throughout is important. Getting a wide range of perspectives from stakeholders in multiple teams can help eliminate blind spots. Testing out hypotheses through simple pilots should be done more often.

OTHER APPLICATIONS

Specifically, the findings of this study can be applied to other similar fulfillment centers across the Amazon network. More broadly, the general approach as well as some of the proposed solutions can be applicable to the broader transportation and logistics industry, as this is a common problem wherever packages are being moved and delivered.