



Transportation & Logistics

CASE STUDY

Train Delay

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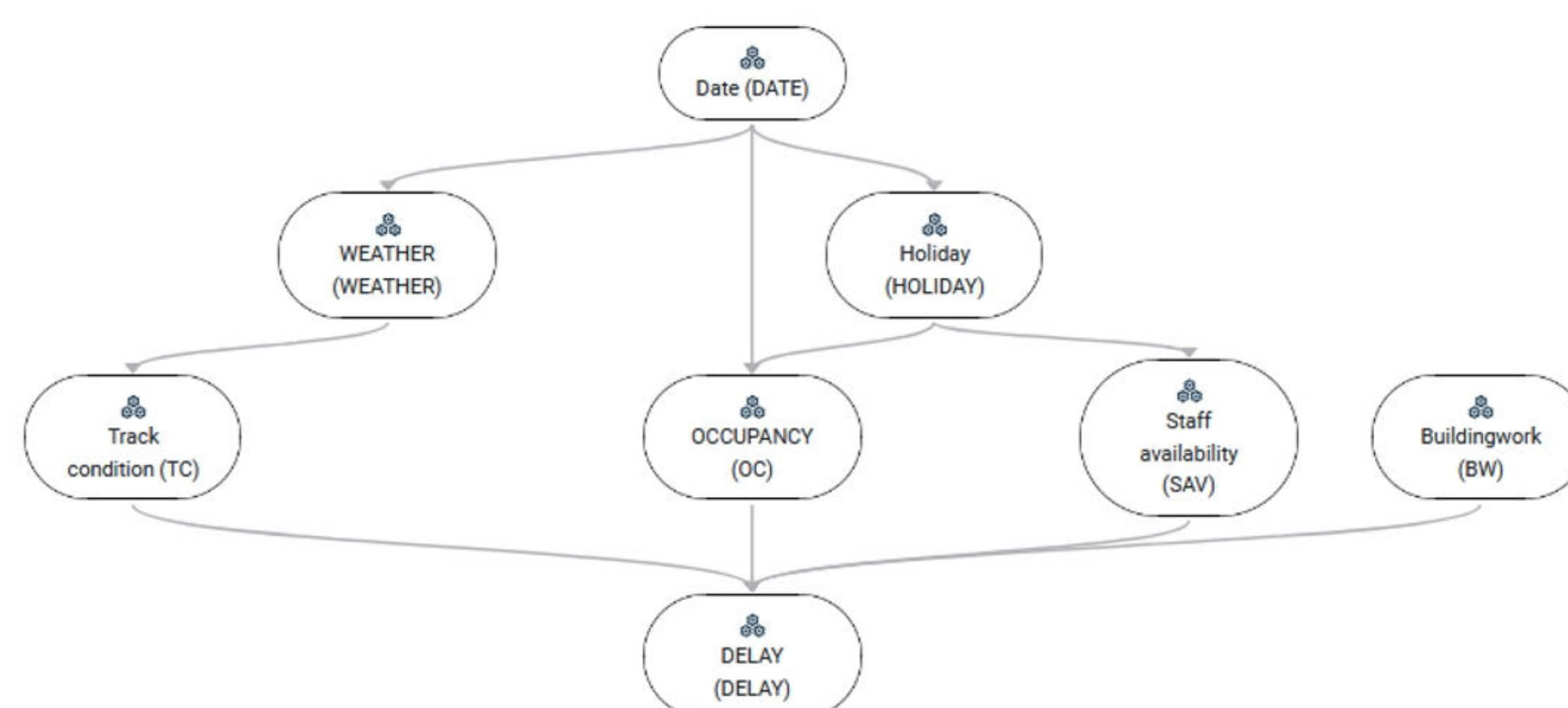
CHALLENGE

Some railway companies face significant challenges with punctuality, impacting customer satisfaction and operational efficiency. Various factors contribute to these delays, including weather conditions, track status, holiday schedules, staff availability, ongoing construction works, and train occupancy. There is an urgent need for a methodical approach to analyse these factors and mitigate delays.

APPROACH

A comprehensive solution was proposed, involving the development of a delay prediction and analysis model using Whyond. This model combines expert's knowledge and data to address the issue:

- **Expertise and Data Fusion:** Expert knowledge is integrated into the algorithm in the form of graphical and numerical representations through causal graphs, enhancing the transparency of relationships between variables.



- **Connections between Decisive Variables:** Key variables such as weather conditions or occupancy are integrated to ensure accurate calculations and a comprehensive understanding of relationships among endogenous variables.
- **Extension to Predictions:** Moving beyond traditional AI's correlation-based predictions, Whyond delves into causal analyses, enabling a robust comparison of delays. In addition, root cause analysis enables the identification of the strongest triggers of misconduct. The following types of questions can be answered with Whyonds.

For example:

- How do specific weather conditions impact the likelihood of train delays?
- What are the key risk factors contributing to increased delays?
- How would enhancing the maintenance of railway tracks in critical areas affect the punctuality of trains, especially under varying weather conditions and occupancy levels?
- **Corner Case Identification and Root Cause Analysis:** Whyond identifies 'corner cases' - rare conditions that can significantly impact train delays and performs root cause analysis to understand why these delays happen. By analyzing factors like construction projects, holiday periods, train usage, staff availability, track condition, and weather warnings, we pinpoint scenarios causing high delays and uncover the underlying causes. This dual approach enables proactive adjustments and resource allocation to minimize delays, enhancing the rail service's punctuality and reliability by addressing not just the symptoms but the root causes of disruptions.

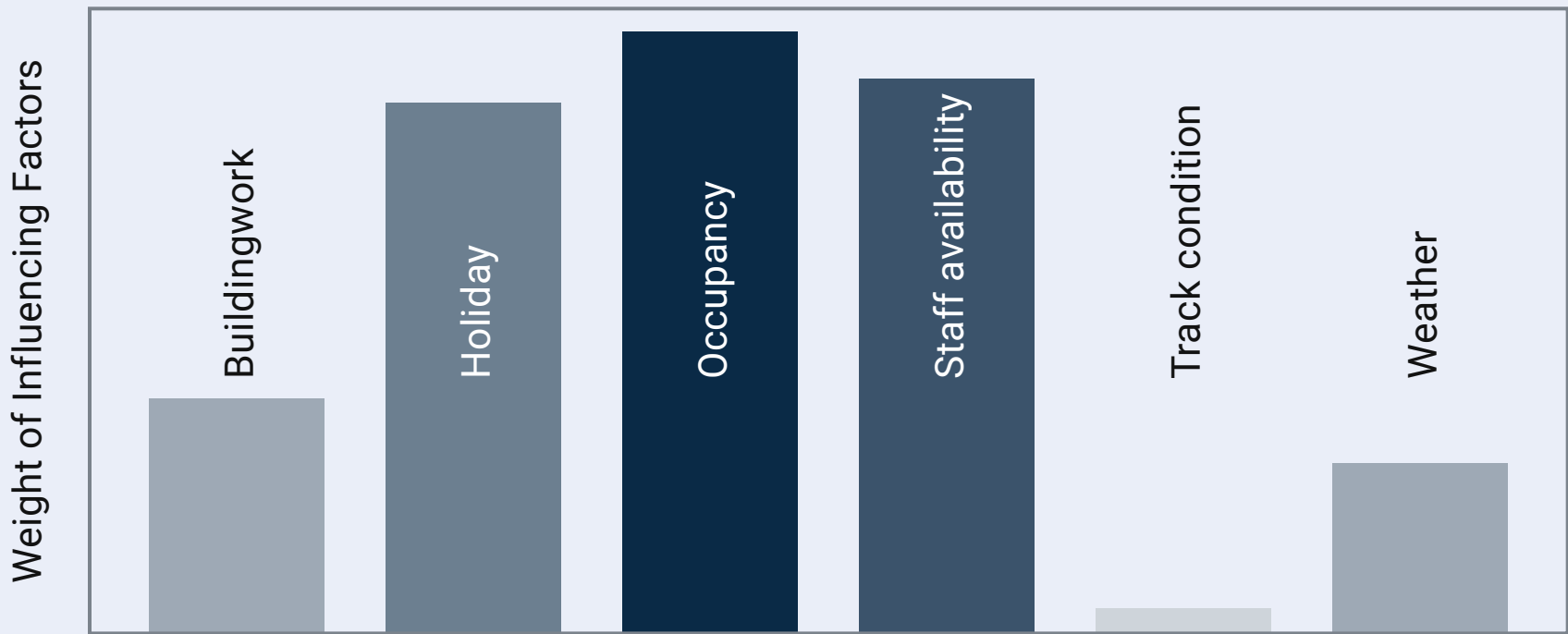
Example of a Corner Case Identification coupled with Root Cause Analysis:

Variable	Explanation
Construction work	Number of major active construction projects
Holiday	Proportion of population on holiday in percent
Occupancy	Train usage rate in percentage
Staff availability	Staff availability rate in percent
Track condition	Maintenance-required track proportion in percent
Weather	Proportion of track length that is affected by weather warnings in percent
Delay	Average train delay in minutes

Example Corner Case Result

Construction work	Holiday	Occupancy	Staff availability	Track condition	Weather	Delay
20	78%	72%	68%	30%	19%	18 min
...

Example Root Cause Analysis Result



IMPACT/OUTCOME

By addressing the multifaceted causes of train delays, the railway company is able to achieve a significant improvement in its operations, leading to enhanced customer satisfaction and operational success.