



Automotive

CASE STUDY

Emergency Brake Assist

Source: Generated by Adobe Firefly

CHALLENGE

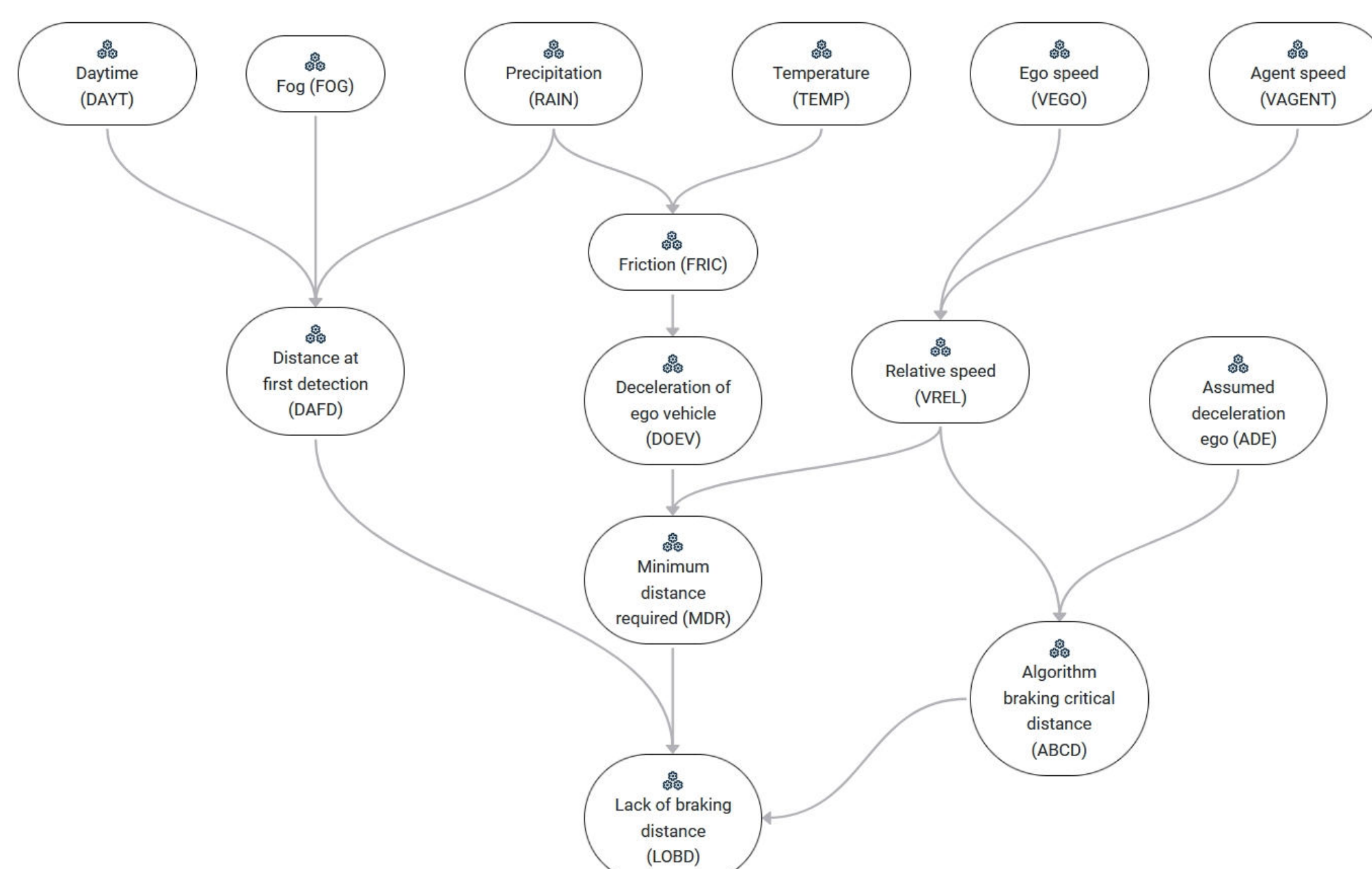
Vehicle emergency brake assist systems are crucial for preventing collisions by providing timely warnings, supporting emergency braking, or automatically engaging brakes in critical situations. The German automotive club ADAC has identified a significant challenge in these systems' performance, particularly under adverse conditions like slippery roads. Their extensive testing revealed that systems often react too slowly on such surfaces, highlighting a gap in their ability to adjust for temperature and wet conditions.

For instance, tests showed that at -1°C on a slightly slippery road, an Audi A6 could avoid a collision at 25 km/h but not at 45 km/h. As those traffic accidents are dangerous for life and limb, this indicates a clear need to improve emergency brake assist systems in order to prevent such collisions under various conditions. With Whyond we implemented a more sophisticated approach to achieve this goal.

APPROACH

Our causal AI Whyond transforms how emergency brake assist systems predict and react to potential collisions. Here's how Whyond makes a difference:

- **Integration of Expert Knowledge:** We incorporate expert knowledge about automotive safety standards and braking system design principles into Whyond through detailed causal graphs enhancing the transparency of relationships between variables.
- **Connections between Decisive Variables:** Whyond integrates crucial variables, including weather conditions and technical parameters of vehicles, into its calculations. This ensures a nuanced understanding of how different factors interact, leading to more accurate and reliable results.



- **Extension to Predictions:** Moving beyond traditional AI's correlation-based predictions, Whyond delves into causal analyses. This allows us to not only predict potential collisions under current conditions but also to explore how altering specific variables (like braking force) could change outcomes.

For example:

- Assessing collision likelihood in heavy rain to understand risk factors.
- Simulating the impact of increasing the Audi A6's braking force on collision avoidance.
- Analyzing past accidents to determine if earlier brake activation could have prevented the collision.

- **Extraction of Triggering Conditions:** A crucial feature of the approach is Whyond's capability to extract relevant triggering conditions for hazardous behaviour directly from causal graphs generated through expert interviews. This feature is particularly significant in the context of the Safety Of The Intended Functionality (SOTIF) norm, which emphasizes the importance of identifying and addressing safety risks in complex systems. Experts in the automotive safety domain require deep insights into triggering conditions to meet SOTIF requirements, making our solution an invaluable tool.

For example:

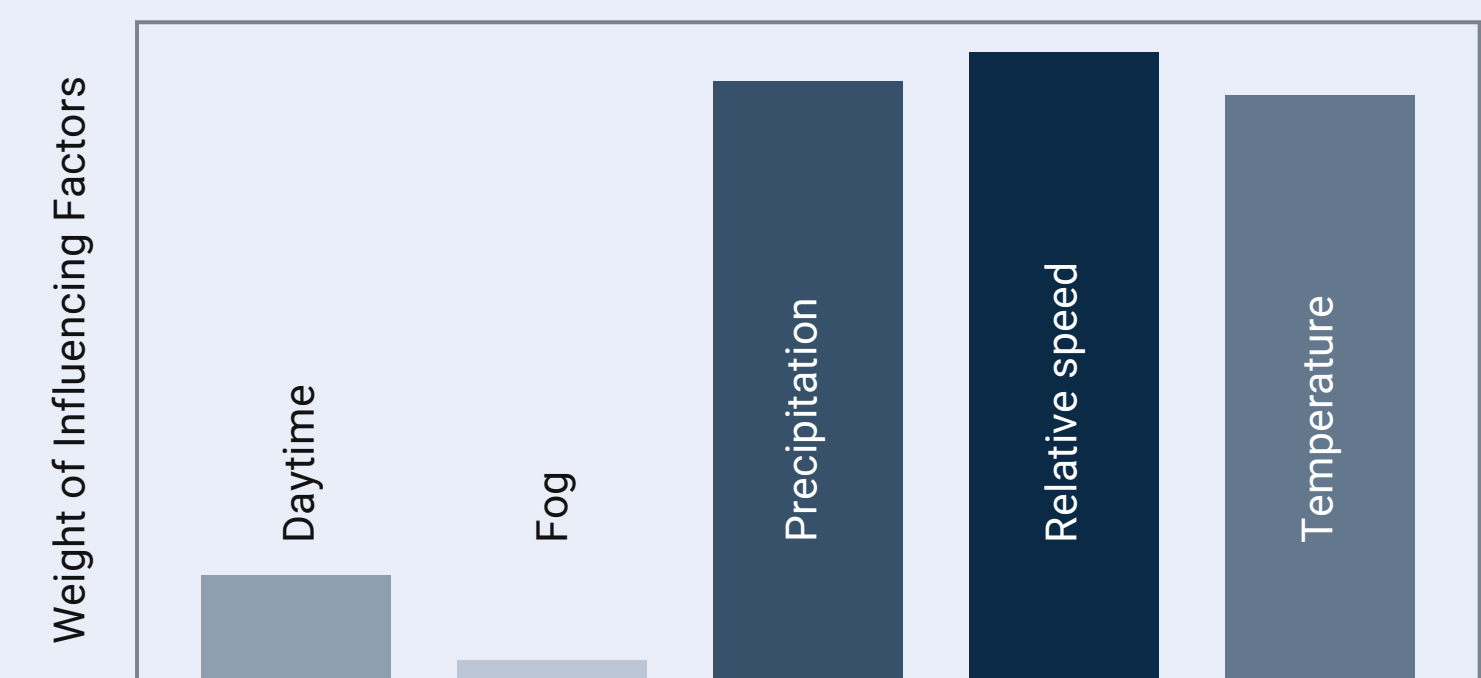
Rain and temperature below zero degrees lead to slippery roads which the brake assist's planning algorithm might not handle safely.

- **Corner Case Identification and Root Cause Analysis:** Whyond's powerful search engine identifies rare but dangerous scenarios leading to severe collisions and pinpoints the primary factors contributing to these outcomes. This enables targeted improvements to system design and functionality.

Example Corner Case Result

Daytime	Fog	Precipitation	Relative speed	Temperature	Probability of collision
9:00 am	2	8 mm/h	31 m/s	-1°C	0.4
...

Example Root Cause Analysis Result



IMPACT/OUTCOME

The introduction of Whyond into safety analysis of an emergency brake assist system has achieved a significant reduction in the likelihood of collisions. This improvement reflects a substantial advancement in vehicle safety, enabling drivers to benefit from more reliable assistance in critical moments.

Key Outcomes

- **Safety Process Enhancement:** Whyond significantly improves the development process of emergency brake assist systems by providing early feedback to developers with advanced insights into how different variables affect safety outcomes.
- **Data-Driven Development:** By utilizing Whyond's causal inference algorithms, developers can analyze specific scenarios that challenge emergency brake assists, such as varying weather conditions and others.