CRASH PREDICTION

Predicting Crashes by Applying Machine Learning on New Sources of Driver Behaviour Data*

INTRODUCTION

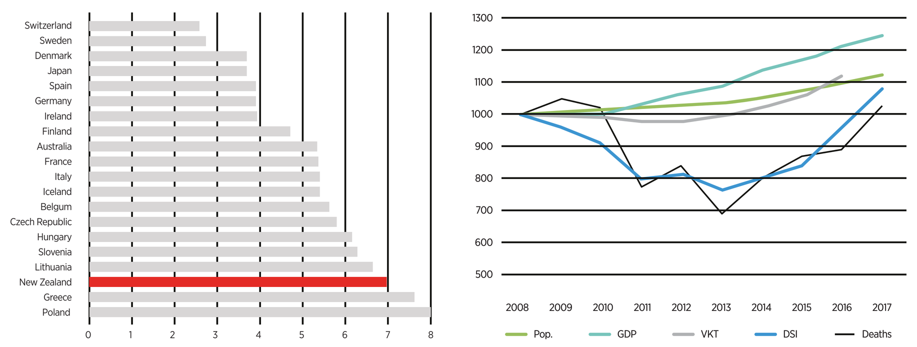
Death and serious injury on New Zealand's roads are increasing, and this isn't just because of increased traffic. In-fact attributing it to one single cause is difficult because existing methods using time consuming observations and measurements to support scientific analysis have reached their limits. New methods using emerging datasets, like EROAD's Harsh Braking, can help reverse this trend and support the governments' plan for Vision Zero (reducing road deaths).

377

deaths in NZ roads in 2018

$4.8bn

social cost of road deaths



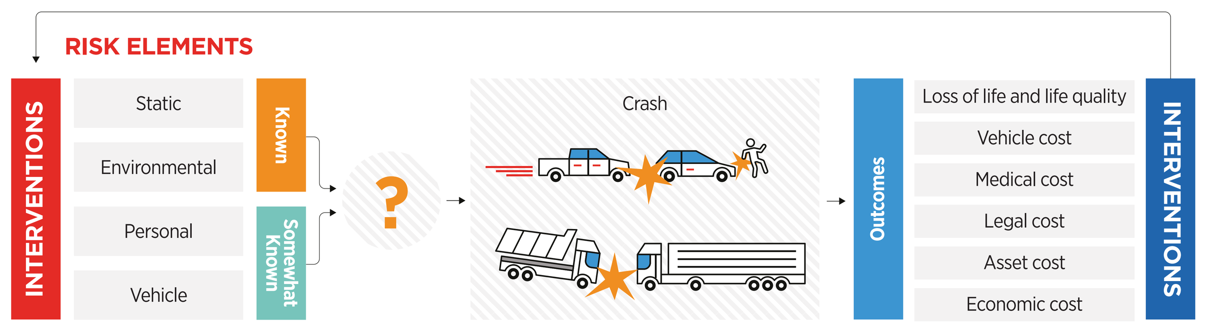
It's about working together

New Zealand has followed the global trend and adopted a Safe Systems approach to road safety. The Safe Systems approach does not lay blame with any one component but instead treats crashes as a holistic failure of the system. Safe Systems comprises four parts:

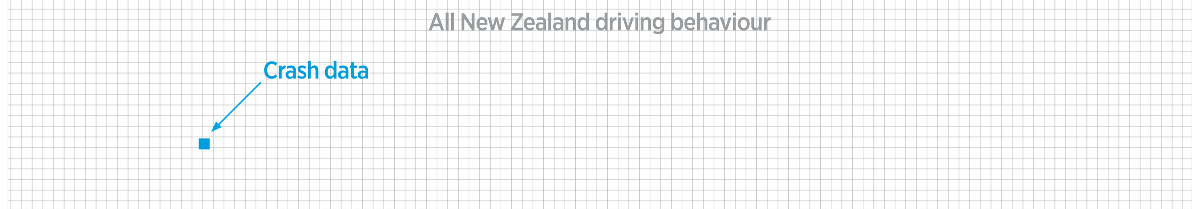
a. Ensuring roads are properly designed and maintained, that roadsides are clear from obstruction, and that surfaces are appropriate for the conditions.
b. Roads have speed limits that are appropriate for their usage and users.
c. Drivers are appropriately licensed and trained, and
d. Vehicles are fit for use.

Sources of driver behaviour data is a crucial gap in the understanding of the Safe Systems approach, which means much of the interventions are in response to crash events, rather than occurring proactively.

Current intervention loop starts with a crash

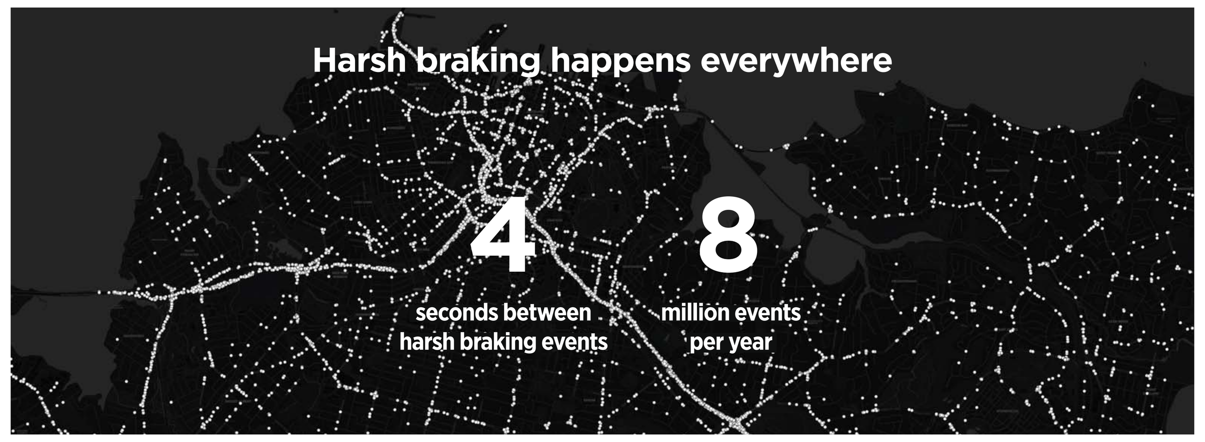


Crashes represent a miniscule dataset



HOW EROAD FITS INTO THE SYSTEM

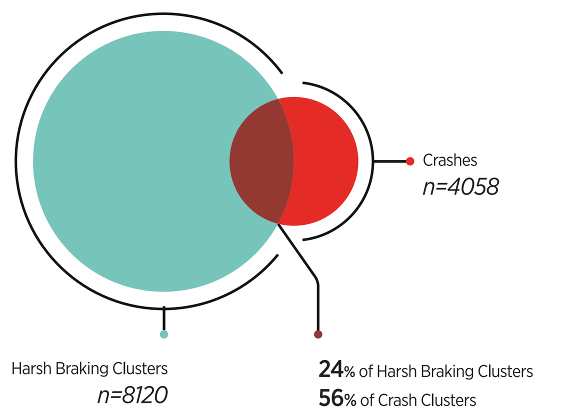
EROAD is a regulatory telematics company, with a substantial subscriber base driving on New Zealand roads. The breadth of this data across New Zealand is significantly larger than the size of the available Crash Analysis System produced by the New Zealand Transport Agency. Studying EROAD's harsh braking dataset provides insight into the locations of potential crashes by correlating each dataset spatially.



METHODOLOGY

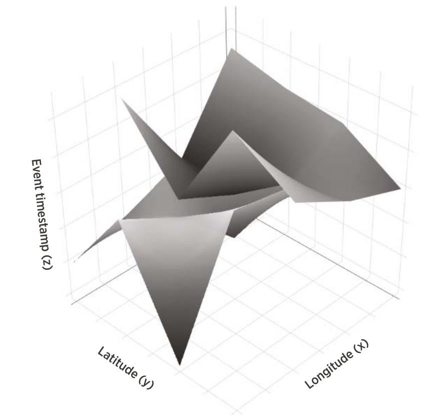
The methodology used spatial clustering, using DBSCAN to reduce noise and focus on dense locations of harsh braking and crashes. Then we converted each cluster into a polygon that could be used to calculate overlaps, both in space and time using a modified Hausdorff distance, using time as the third access. Once these attributes were calculated, an SVM model was used to create the confusion matrix below and yield the False Positive predictions of interest. These are the location on the network where we believe are at further risk of a crash.

Strong spatial similarity between harsh braking and crashes



n=7589	Actual	
Prediction	No Crash	Crash
No Crash	5988 (TN)	366 (FN)
Crash	101 (FP)	1143 (TP)

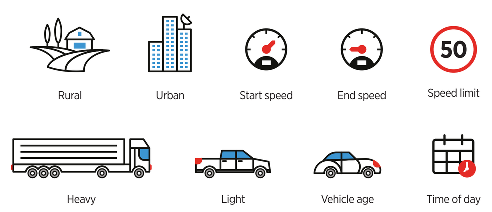
What about the time element of spatial clusters?

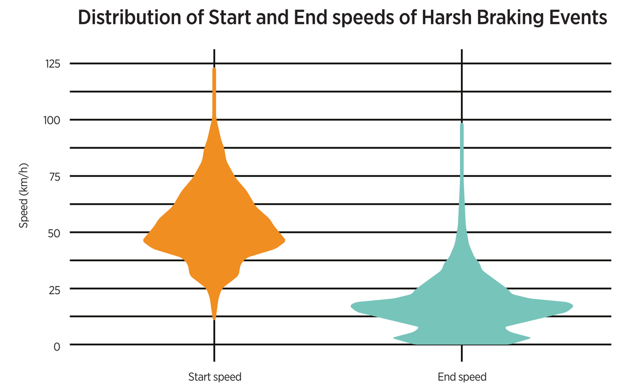


For each cluster:

- Calculate the area overlap
- Calculate 3D - hausdoorf distance
- Time of harsh braking / crash as z

Other considerations

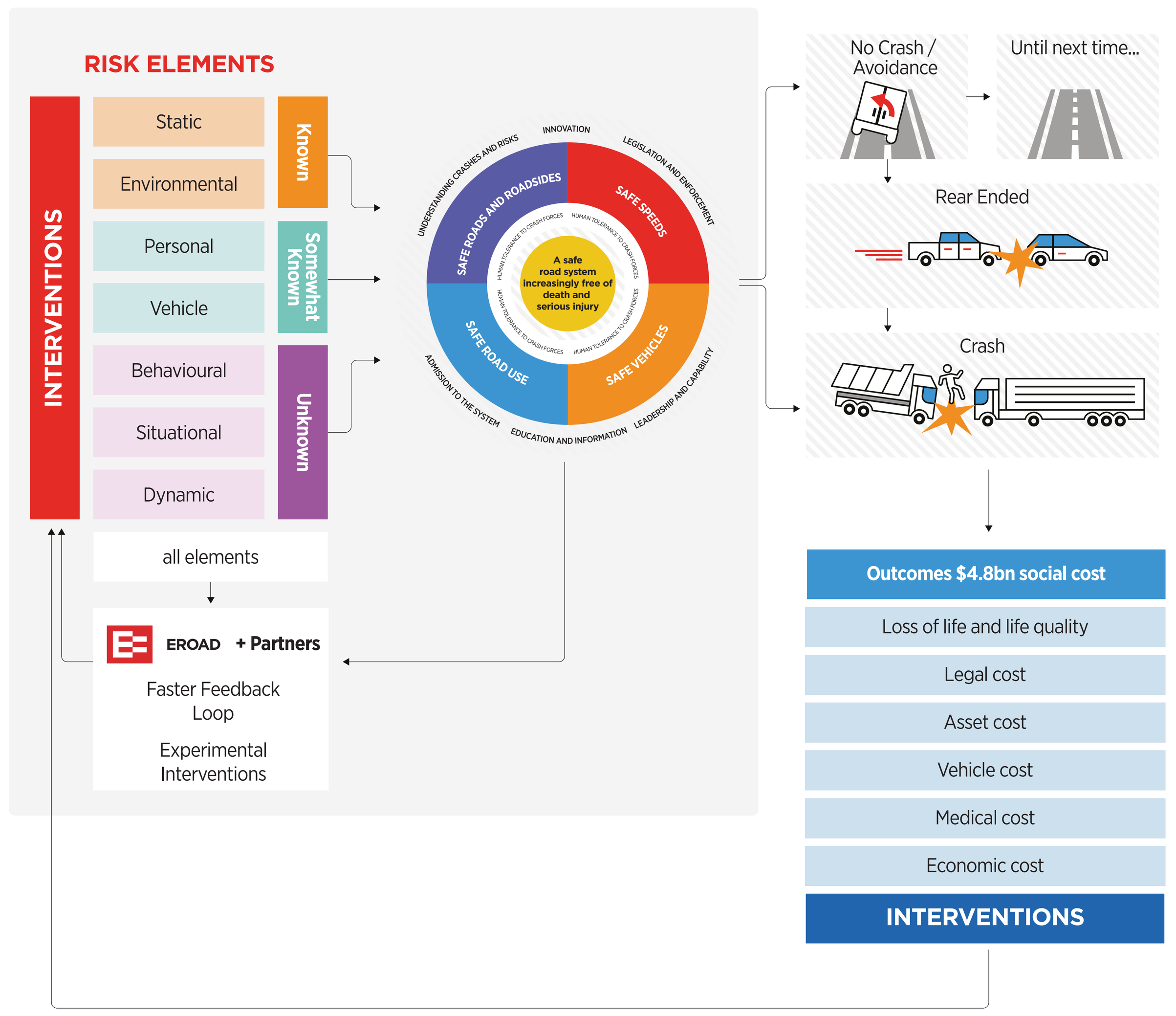




A FASTER FEEDBACK LOOP

By studying these precursors to crashes, faster insights are gained into the efficacy of crash interventions. Rather than waiting years for a response in the signal of crash data, transport authorities can receive faster feedback on more cost-efficient interventions.

Feedback loop starts with driver behaviour



SAFER, MORE PRODUCTIVE ROADS

About EROAD

EROAD develops technology solutions (products and services) that manage vehicle fleets, support regulatory compliance, improve driver safety and reduce the costs associated with driving. EROAD also provides valuable insights and data analytics to universities, government agencies and others who research, trial and evaluate future transport networks. This data enables those who use the roads to influence the design, management and funding of future transport networks.

We believe every community deserves safer, more productive roads

REFERENCES

A.-C. Kristianssen, R. Andersson, M.-Å. Belin, and P. Nilsen, "Swedish Vision Zero policies for safety –A comparative policy content analysis," *Saf. Sci.*, vol. 103, pp. 260–269, Mar. 2018., N. Z. Ministry of Transport, Research and Statistics, "Overview of road safety in New Zealand Contents., Deloitte, "Qualitative and Quantitative Analysis of the New Zealand Road Toll: Final Report," 2017., J. C. Anderson, "Unobserved Heterogeneity and Spatial Correlation: Statistical and Econometric Analyses of Heavy-Vehicle Hard Braking and Crash Frequency by Crash Type," Oregon State University, 2018., NZ Transport Agency, "Crash Analysis System (CAS) | NZ Transport Agency." [Online]. Available: https://www.nzta.govt.nz/safety/safetyresources/crash-analysis-system/. [Accessed: 14-Apr-2019]., M. Hahsler, M. Piekenbrock, and D. Doran, "dbscan: Fast Density-based Clustering with R.", H. Alt, P. Braß, M. Godau, C. Knauer, and C. Wenk, "Computing the Hausdorff Distance of Geometric Patterns and Shapes," in *Discrete and Computational Geometry*, B. Aronov, S. Basu, J. Pach, and M. Sharir, Eds. Springer, Berlin, Heidelberg, 2011, pp. 65–76., D. Zhang, L. Zou, Y. Chen, and F. He, "Efficient and Accurate Hausdorff Distance Computation Based on Diffusion Search," *IEEE Access,* vol. 6, pp. 1350–1361, 2018., B. Schölkopf and A. J. Smola, *Learning with kernels : support vector machines, regularization, optimization, and beyond.* MIT Press, 2002.

AUTHORS

Gareth Robins
Director of Analytics,
EROAD
gareth.robins@eroad.com

Dr Salvador Hernandez
Associate Professor
School of Civil and Construction Engineering
Oregon State University
sal.hernandez@oregonstate.edu

Dr Jason Anderson
Research Associate,
Department of Civil and Environmental Engineering
Portland State University
jason.c.anderson@pdx.edu