



# EDR TRIGGER DATA-DRIVEN ANALYSIS OF SAE PROPOSAL

SG-EDR-32 MEETING 01-12-2022



- » Regulation (EU) 2019/2144 of the European Parliament and of the Council (General Safety Regulation, GSR) lays down a general obligation for motor vehicles to be equipped with certain advanced vehicle systems, including Event Data Recorders (EDR)
- » EDR is a system recording and storing critical crash-related parameters and information before, during and after a collision
- » EDR for HD vehicles is in focus
- » To ensure international harmonization of technical requirements applicable on type approval of HD vehicles, the EDR technical requirements will be established under the umbrella of the United Nations World Forum for Harmonization of Vehicle Regulations of the United Nations Economic Committee for Europe (UNECE).
- » Proposals for triggers in order to activate DER are provided e.g. by SAE J2728-1
- » This document provides an analysis of proposed SAE triggers based on available data

## Acceleration trigger (heavy braking)

- Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s) and 22.5 km/h/s (14.0 mph/s) and persists beyond that threshold for at least 0.5 seconds.

## Last stop trigger

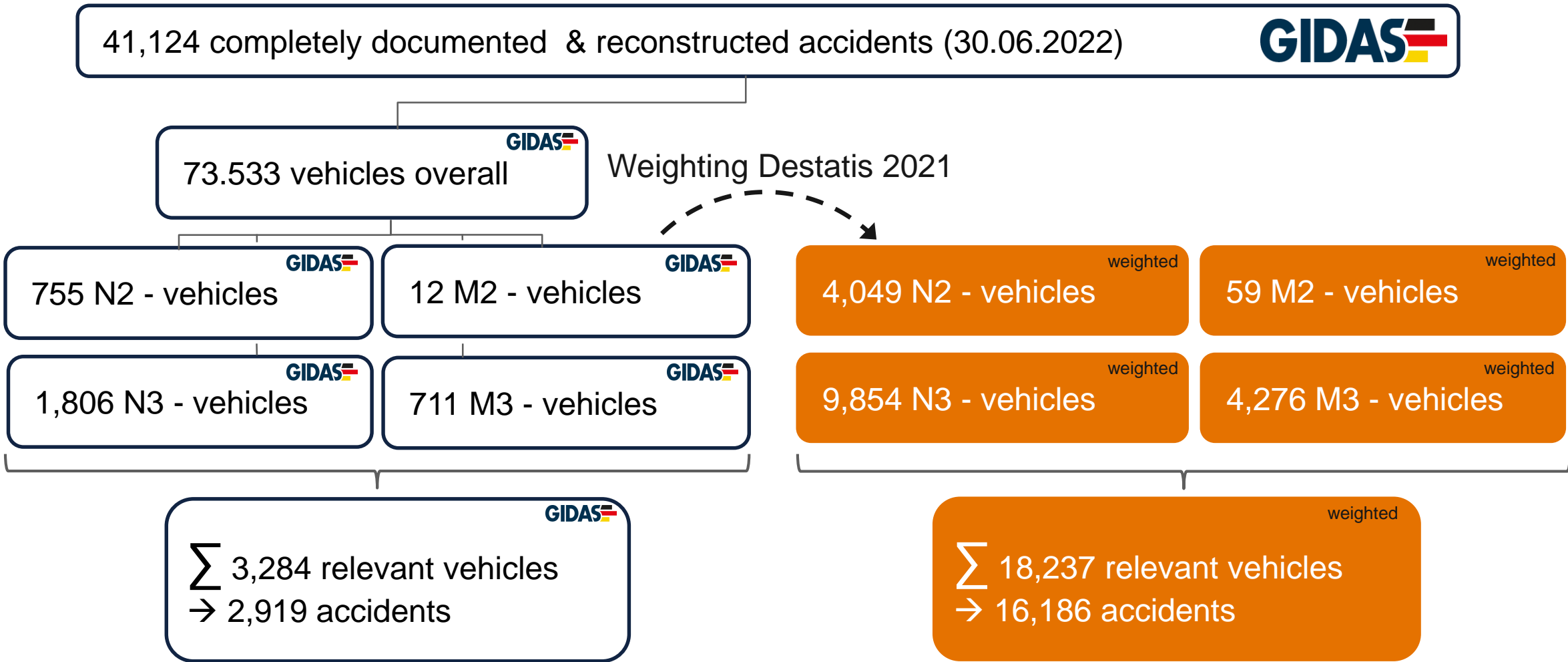
- The intent of this trigger is to capture an event when the vehicle has come to a complete stop for a period of time. The last stop event start will be the time the threshold is crossed. A suggested threshold is when the vehicle speed falls below 3.0 km/h (1.9 mph) for 15 seconds or more. To prevent last stop events from being overwritten due to the movement of the vehicle after an incident of interest, the last stop trigger cannot reoccur until the vehicle speed reaches a speed of 24.0 km/h (14.9 mph) or more for a minimum of 6 seconds. The act of turning the ignition off will not directly trigger a last stop event.

## Safety system triggers

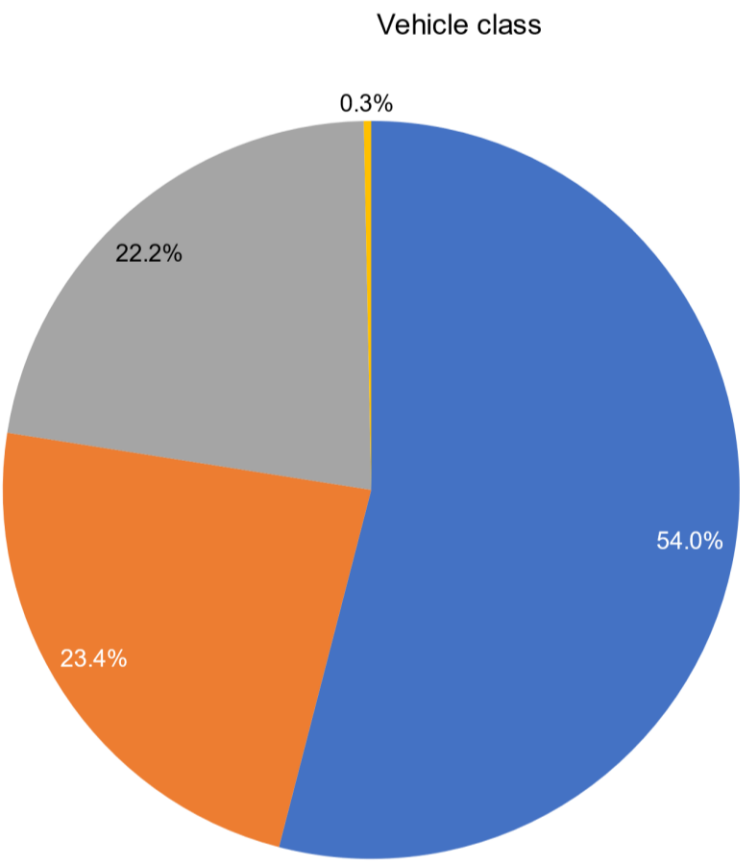
- Systems that are installed for control or driver alerts from safety systems should trigger an event record. Such as:
  - o Safety restraint system deployment
  - o ABS System
  - o Adaptive cruise control/automated braking
  - o Electronic stability control
  - o AEBS (Advanced Emergency Braking System)

- » **Analysis HD vehicles EDR trigger proposal by SAE**
- » **Data driven analysis approach**
  
- » **Analysis of accident data by means of GIDAS**
  - » **Focus on True Positives**
  - » GIDAS (German in-depth accident study)
  - » Analysis of truck accidents from two regions of Germany
  - » Focus on accidents recorded, i.e. what proportion of collisions would EDR capture with the proposed triggers
  
- » **Analysis of field operational data**
  - » **Focus on False Positives**
  - » Data from 2008-2012
  - » Data from European Roads (with focus on Germany)
  - » N = 34 trucks; approximately driving for 1 year; 361,245 km recorded data
  - » Naturalistic driving data from euroFOT project (funded by the European Commission)
  - » Focus on false positives using the proposed triggers, i.e. how often would EDR be triggered during normal driving

» Overview on available data for analysis

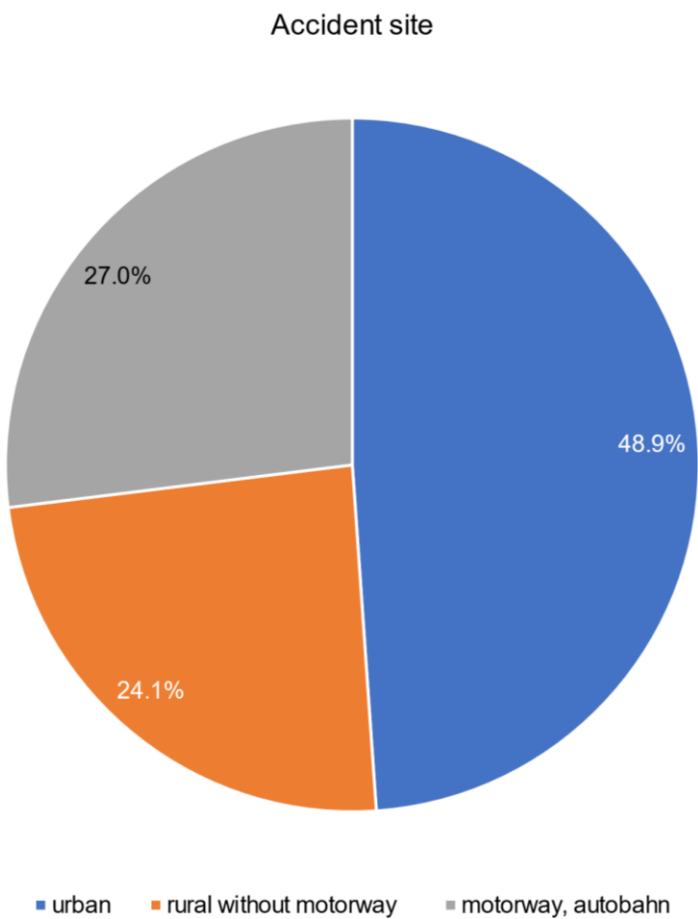


## » Descriptive analysis of data



n = 18,237 vehicles

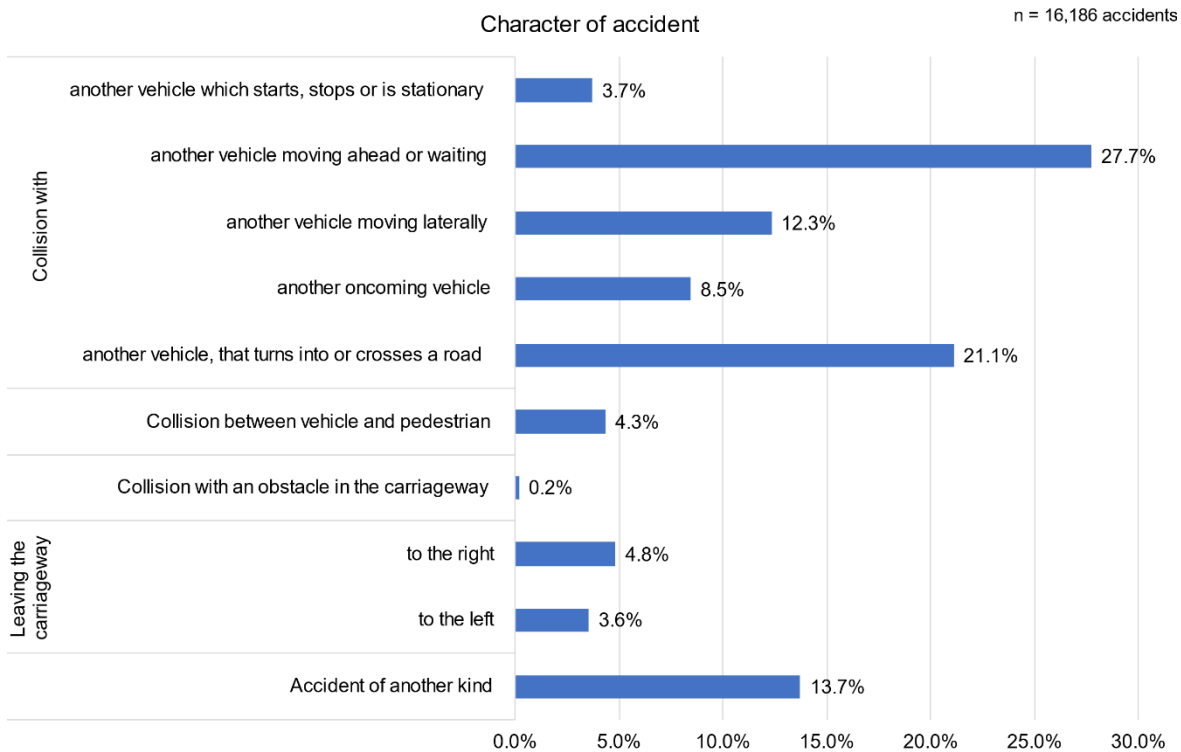
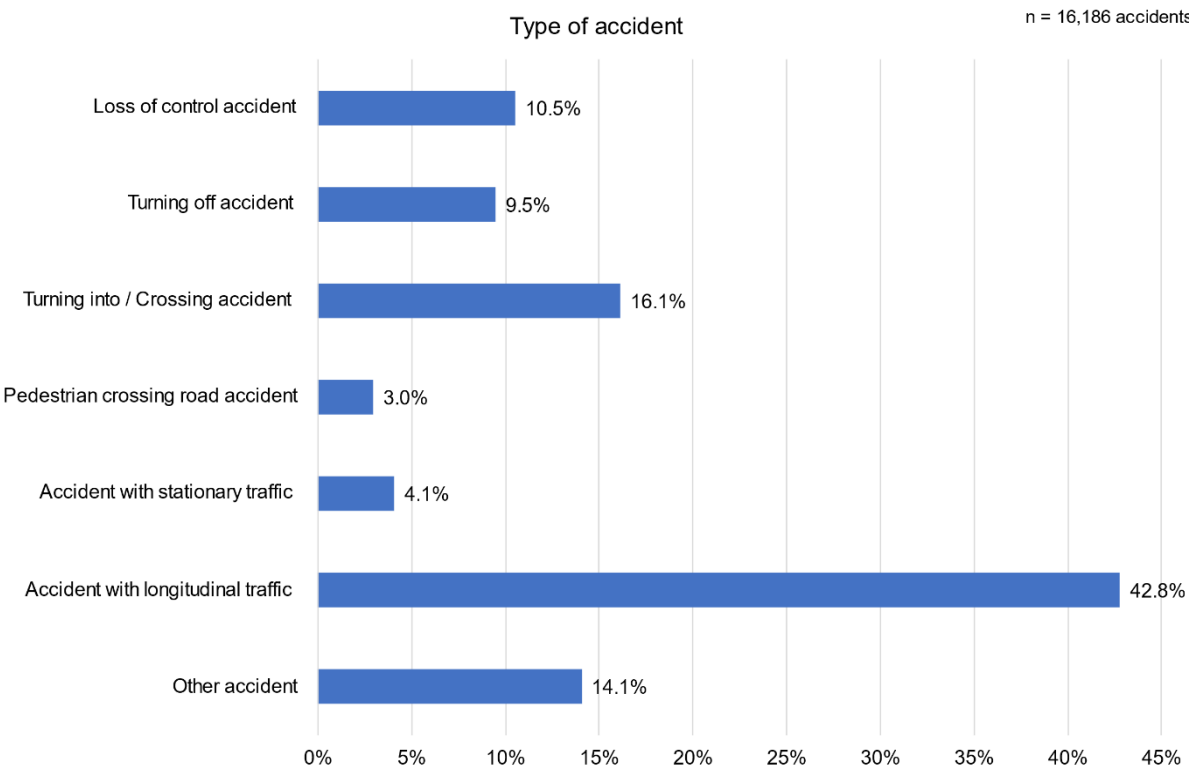
- N3 - vehicle
- M3 - vehicle
- N2 - vehicle
- M2 - vehicle



n = 16,186 accidents

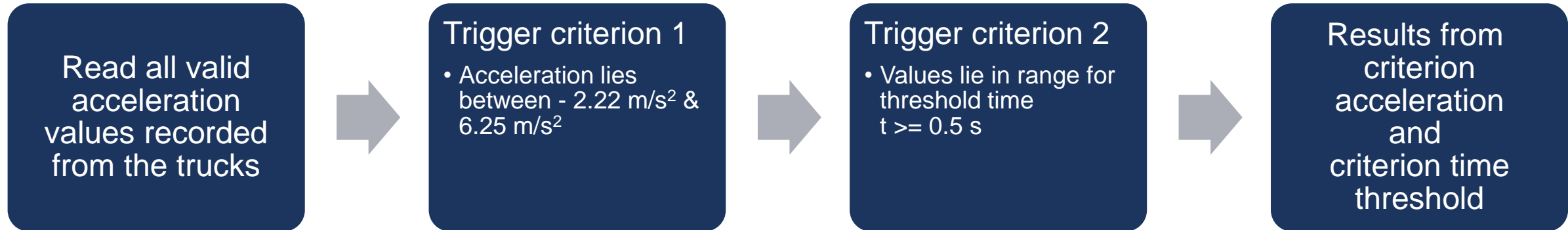
- urban
- rural without motorway
- motorway, autobahn

## » Descriptive analysis of data



# Results True Positive Analysis (GIDAS Data)

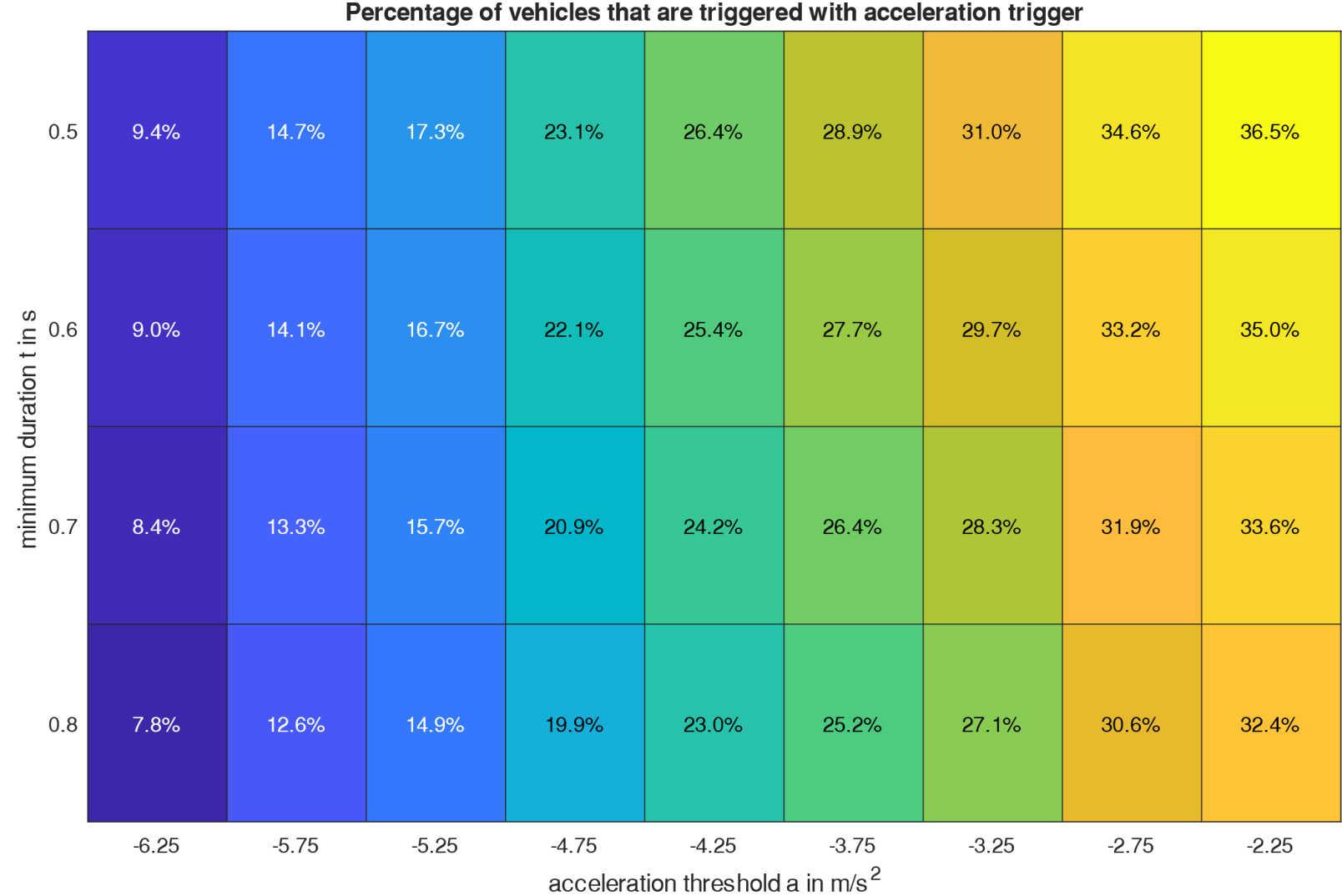
## SAE Acceleration recommendations



→ Trigger criterion 2 will be analysed with  $t=0.5$ s,  $t=0.6$ s,  $t=0.7$ s and  $t=0.8$ s in order to see the influence of the threshold time

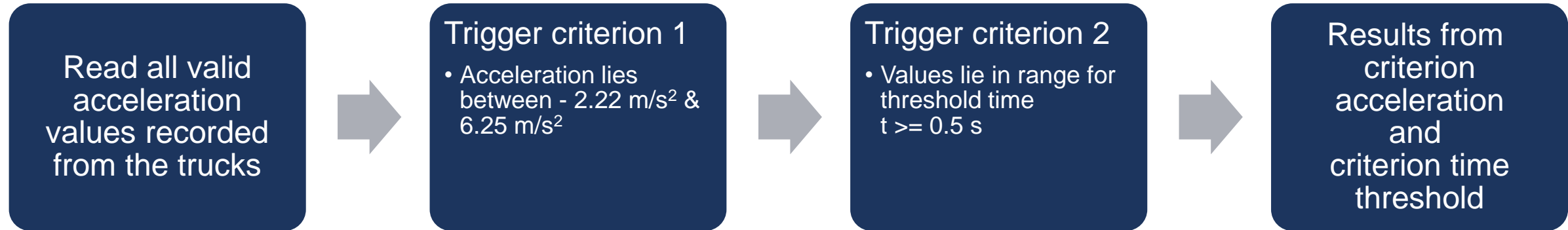


» Trigger analysis



# Results False Positive Analysis (euroFOT Data)

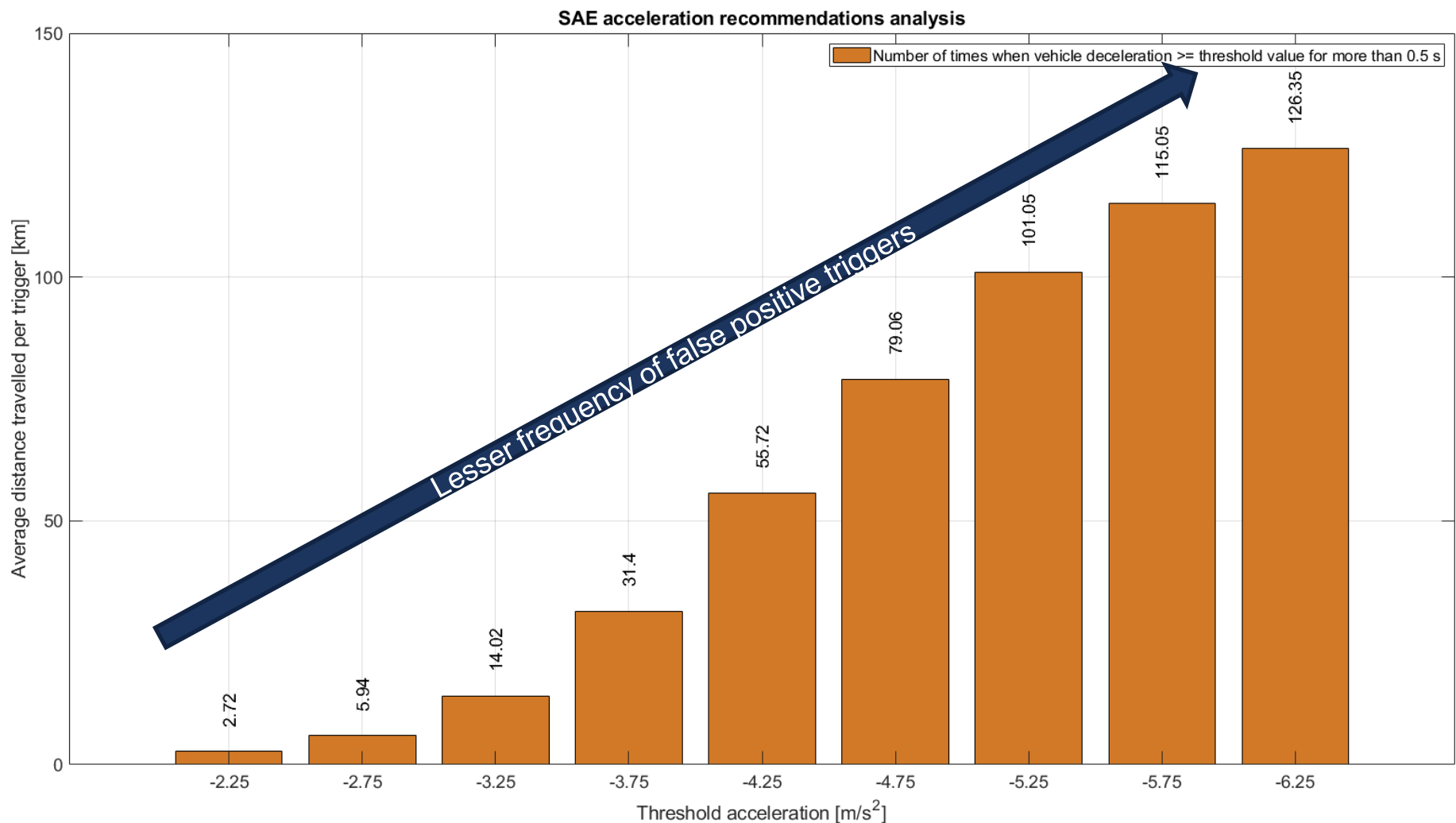
## SAE Acceleration recommendations



→ Since no crash occurred in the euroFOT drives, the values that pass criterion 2 represent false positive cases

# Results False Positive Analysis (euroFOT Data)

## SAE Acceleration recommendations



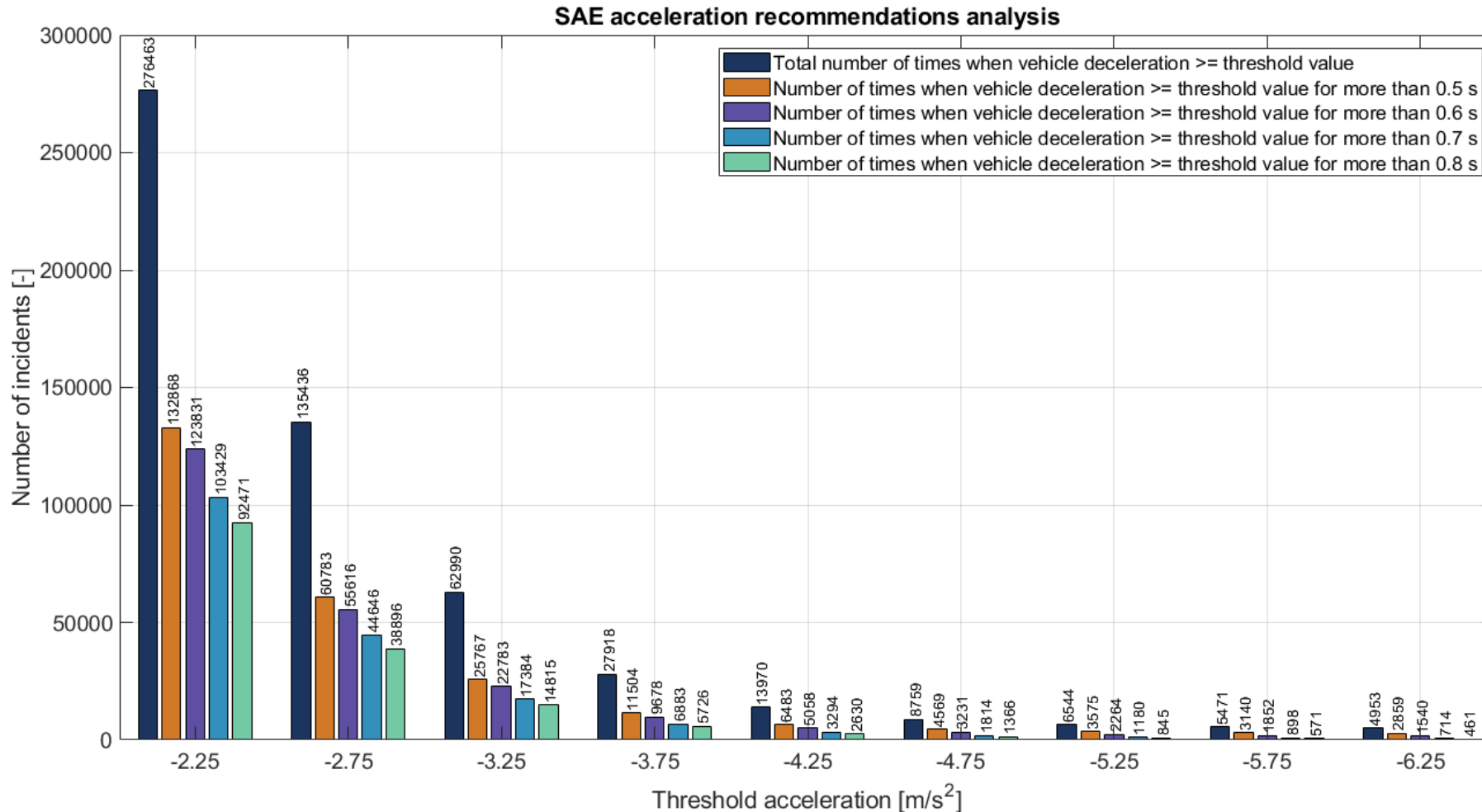
- Total distance travelled by 34 trucks over the entire period is approximately **361,245 km**
- **With lower thresholds for deceleration values, the frequency of triggers (false positives) drastically increases**

Deceleration [m/s <sup>2</sup> ]	Avg. distance travelled per trigger [km]
2.25	2.72
6.25	126.35

- **However, the frequency of false positives still remains high with higher threshold deceleration values**
- Setting higher thresholds (higher than 6.25 m/s<sup>2</sup>) might not be effective because it is difficult for the vehicle to reach such high deceleration even in a case of emergency braking

# Results False Positive Analysis (euroFOT Data)

## SAE Acceleration vs longer time thresholds



- SAE: Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s, 2.22  $\text{m/s}^2$ ) and 22.5 km/h/s (14.0 mph/s, 6.25  $\text{m/s}^2$ ) and persists beyond that threshold for at least 0.5 seconds.
- Analysis with longer time thresholds (0.6 s, 0.7 s and 0.8 s) was performed.
- The number of triggers generated was compared.
- **The number of triggers decreased with increasing threshold for both acceleration and time.**

# Results False Positive Analysis (euroFOT Data)

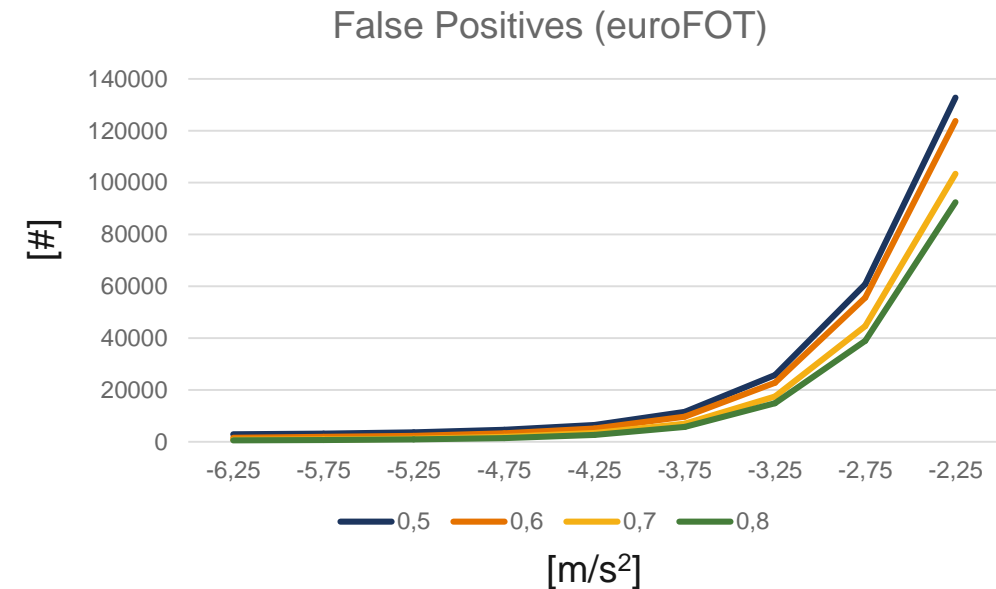
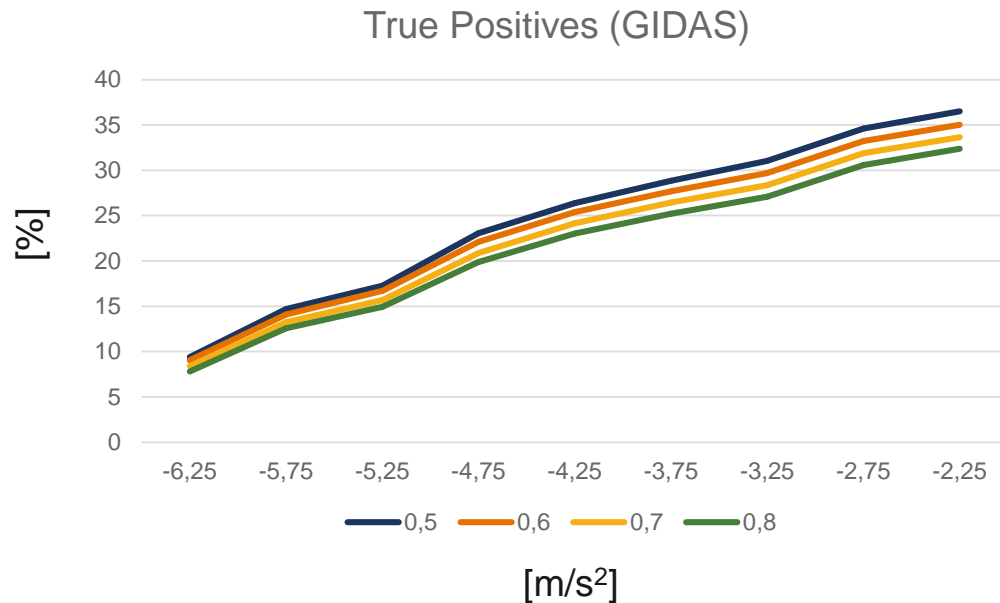
## SAE Acceleration vs longer time thresholds

Avg. distance travelled per trigger [km]

Threshold time [s] → Deceleration [m/s <sup>2</sup> ] ↓	0.5	0.6	0.7	0.8
2.25	3	3	3	4
2.75	6	6	8	9
3.25	14	16	21	24
3.75	31	37	52	63
4.25	56	71	110	137
4.75	79	112	199	264
5.25	101	160	306	428
5.75	115	195	402	633
6.25	126	235	506	784

- SAE: Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s, 2.22 m/s<sup>2</sup>) and 22.5 km/h/s (14.0 mph/s, 6.25 m/s<sup>2</sup>) and persists beyond that threshold for at least 0.5 seconds.
- Analysis with longer time thresholds (0.6 s, 0.7 s and 0.8 s) was performed.
- The average distance travelled by a truck before receiving a false positive is compared for various time thresholds.
- **On average, the distance travelled per km increased significantly with longer time threshold.**

- » The data cannot be compared directly
- » From 3.25 m/s<sup>2</sup> the false positive rate increases strongly
- » It seems that the trigger criterion „threshold“ has a significant influence on false positives, not so much on true positives



- » **Proposal:**
  - » acceleration threshold: 3.25 m/s<sup>2</sup>
  - » time threshold: 0.7 sec

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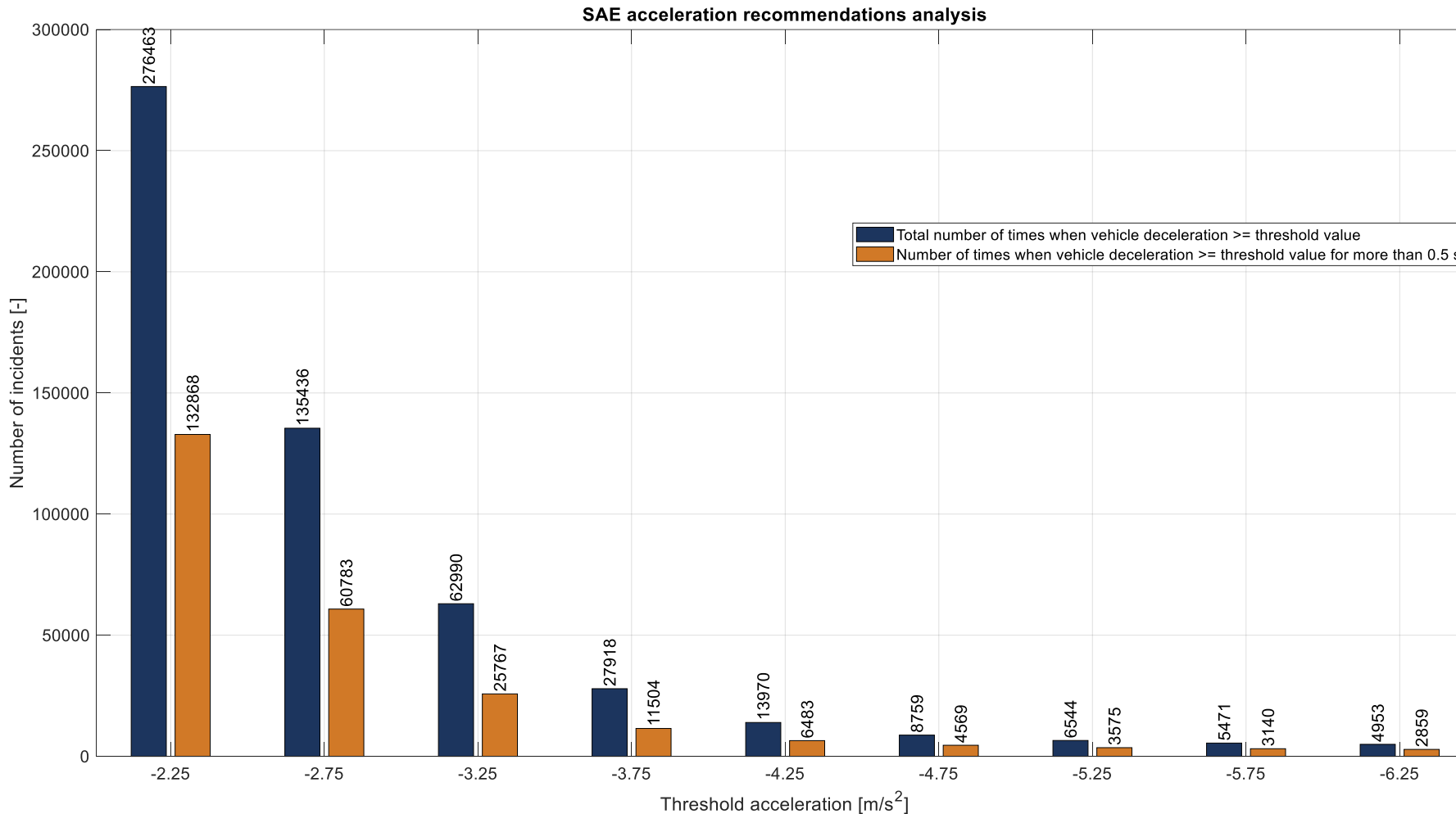






# Results False Positive Analysis (euroFOT Data)

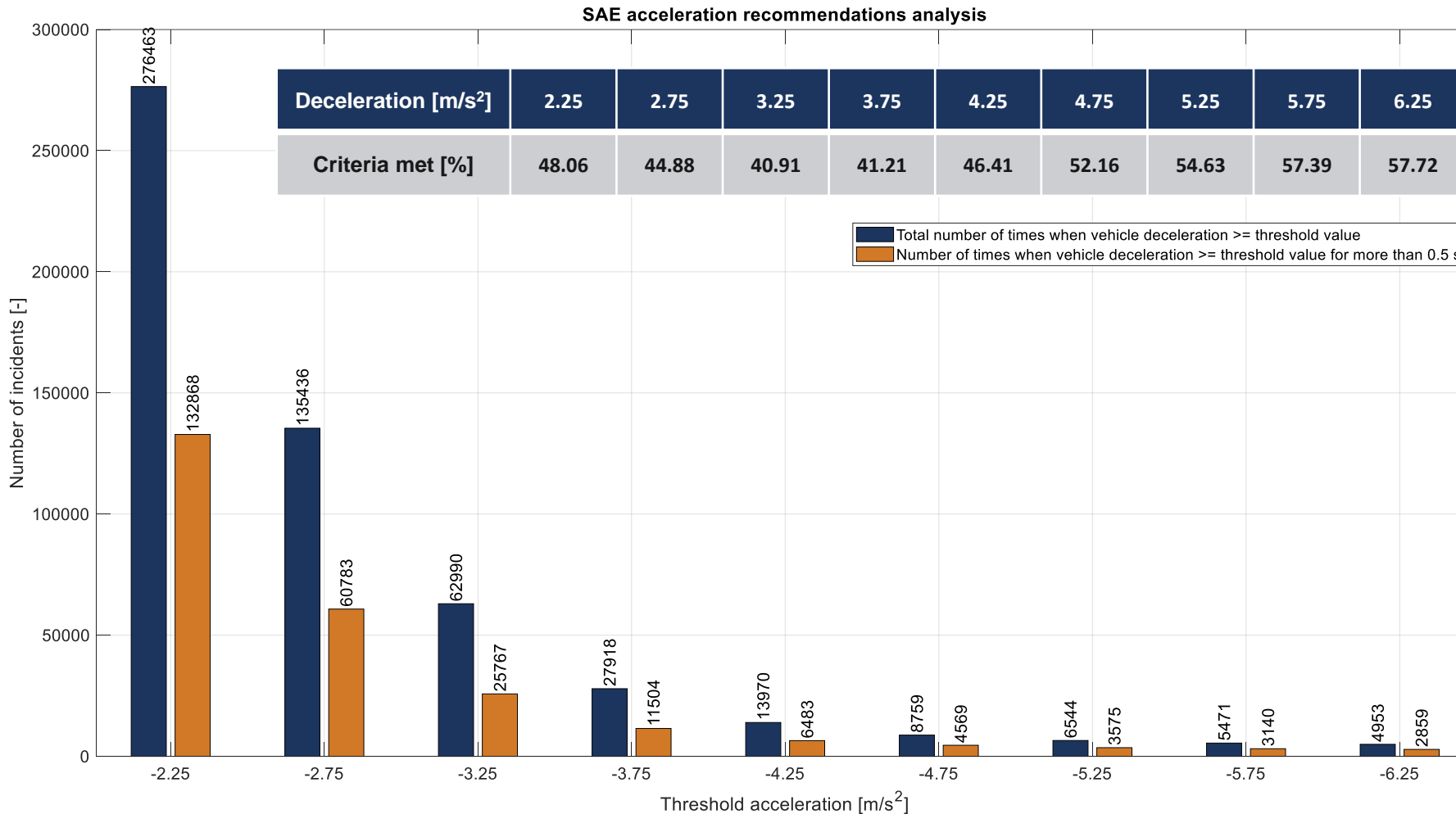
## SAE Acceleration recommendations



- SAE: Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s, 2.22 m/s<sup>2</sup>) and 22.5 km/h/s (14.0 mph/s, 6.25 m/s<sup>2</sup>) and persists beyond that threshold for at least 0.5 seconds.
- Acceleration measurements corresponding to 34 trucks was analysed with respect to various deceleration threshold values that lie in the range suggested by SAE
- **No crash events** exist in the trips made by the trucks

# Results False Positive Analysis (euroFOT Data)

## SAE Acceleration recommendations



- SAE: Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s, 2.22 m/s<sup>2</sup>) and 22.5 km/h/s (14.0 mph/s, 6.25 m/s<sup>2</sup>) and persists beyond that threshold for at least 0.5 seconds.
- Acceleration measurements corresponding to 34 trucks was analysed with respect to various deceleration threshold values that lie in the range suggested by SAE
- **No crash events** exist in the trips made by the trucks
- **The SAE criteria is met more than 40% of the times when the vehicle speed changes at a threshold rate (deceleration) → high possibility for false positive triggers**

- » The data cannot be compared directly
- » It seems that the trigger criterion „threshold“ has a significant influence on false positives, not so much on true positives

