SMART SAFETY





for Transport Safety **Management & Planning**

Advanced Mobility Analytics Group's (AMAG's) Safe Mobility Alert Real Time (SMART) Digital Platform, offered via Software as a Service, is designed to support Vision Zero and Safe Systems goals to improve road safety. Using video analytics, Al, Deep Learning, and Advanced Econometrics, the platform facilitates proactive management of safety for transport networks. While the 'heart' of SMART is the continuous 24/7 monitoring of sites through the SMART **OPERATIONS** Product, the SMART SAFETY Product enables deeper insights to inform long-term engineering site improvements.

SMART SAFETY is used to conduct 'deep dive' diagnostic analyses for tailored site engineering and operational improvements and to evaluate the effectiveness of countermeasures. SMART SAFETY is deployed to diagnose and mitigate chronic safety problems and deficiencies through post-processing of between 2 and 7 days of video (typically). Collectively, SMART SAFETY provides accurate, quantitative, comprehensive, and detailed insights into crash risk that other methods simply cannot match.







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Software as a Service (SaaS) architecture

AMAG's digital platform is built for the cloud with mobile first design in mind, and uses cutting edge technologies ready hosted and available on the cloud for customers just a few mouse clicks away.

AMAG's SaaS application does not require the deployment of large computing infrastructure at a client's location, and is accessible from a variety of devices, anywhere, anytime.

AMAG's SaaS solution also provides a highly scalable application with exemplary computing performance. It is able to process data of any size, and supports excellent rendering, data querying, and various transactions. The AMAG digital platform is also designed with security in mind, as it ensures data security and integrity in every layer of the software.



The AMAG SaaS enables users to:

- Ensure availability, continuity, and performance with enterprise software
 Develop in-house capability
 - for problem solving and decision-making
 - Reduced total cost of ownership and capital expenditure (compared to on-prem)
 - Stay up to date with new features

- Cross-product benefits via video analytics
- Improve security with defence in depth architecture
- Reduced environmental impact with improved energy efficiency
- Focused on delivering stateof-the-practice transport analytics and insights

SMART SAFETY License Configuration & Site Level Data Input

The SMART SAFETY Module is based on nearly two decades of research and development, and uses advanced video analytics with AI, Deep Learning, and Advanced Econometrics techniques to measure and detect a variety of interactions among road users (e.g. vehicles, pedestrians, bicyclists, etc.) as well as operational aspects of site, so that a complete risk assessment can be thoroughly explored and assessed. Video and crash data from two to three locations within a jurisdiction (at a minimum) are used to calibrate SMART SAFETY for crash risk. Each user is provided a unique login to the SMART platform, with user access levels as required to various products within the platform. User management can be on-site or provided by AMAG.

SMART SAFETY enables the saving of analyses of multiple sites, so that meaningful across-site and within-site comparisons can be made within a jurisdiction. Transportation network locations suitable for SMART SAFETY analysis include but are not limited to intersections (signalized and unsignalized), road segments (e.g. on-ramps, weaving sections, two-lane road sections), rail-road crossings, school zones, and shared use paths.

Locations are added for SMART SAFETY analysis through a customised interface for a particular jurisdiction. Site-level information is required to support the analysis of SMART SAFETY, and

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- Site Management.

 ☆ Operations Data

 → Flows

 ② Speeds

 ▷ Violations

 Creath Risk Visualizations

 ③ Heat Maps

 ◎⁹ Trajectories: Map View

 -¹ Trajectories: Camera View
- D Conflict Video Clips
- ✓ Crash Forecasts
- E Summary
- ∑ Crash Risk By Type
- Crash Risk By Severity

is provided through a user-friendly interface that enables camera view identification, video uploads, camera calibration, and road-user movement identification. Local crash data are used to calibrate the crash frequency forecasts uniquely for the jurisdiction.

Camera views at a site are managed through the Site Data Input function, and enable SMART SAFETY to align the camera video with site characteristics and ground truth.



SMART SAFETY

Site-Level Operations Data: Flows, Speeds, and Violations

The operation of a site is essential to informing crash risk and road user safety. SMART SAFETY negates the need for supplemental operations data from other sensors, and provides dashboards of road users flows, speeds, and violations as standard outputs. Extensive filtering can be performed within these operations dashboards, including time of day, day of video observation, site, and road user types. All tables, data, and graphs can be exported to CSV, PNG, or pdf files as appropriate, or directed to a report via the report manager. A filter is also available to calculate flows by approach or for the entire intersection. Flow data are detailed, and provide information not available from traditional sensors, including for example bicycle flows within pedestrian crosswalks.

Speed data are useful for assessing compliance with speed limits, for feedback on design feature effects on speed (e.g. traffic calming,

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warning signs), and for examining speed differentials among road user types (e.g. cars versus bicycles, motorcycles versus trucks).

Violations data are notoriously difficult to collect using other methods, but are routinely collected and computed across road users. Pedestrian spatial violations of crosswalks, for example, is an important determinant of pedestrian-involved crash risk. Similar violation profiles are generated for cyclists, and vehicles with regard to speeding. Future enhancements will include and red-light running and wrongway bicycle riding among other feature upgrades.





Crash Risk Visualizations: Conflict Derived Risk Heat Maps, Trajectory Maps, and Video Clips

SMART SAFETY harnesses several visualisation dashboards to capture, explain, and convey observed crash risks at a site. These visualisations include conflict derived crash risk heat maps, trajectory maps, and video clips.

Conflict derived crash risk heat maps provide unprecedented insight into site safety by mapping both WHEN and WHERE crash risk, by type of risk, is present. SMART SAFETY utilizes several crash risk metrics to generate heat maps across the types of crash risk, depending on which metrics relate to crash type. Currently there are 12 different types of crash risk monitored, which can be filtered to focus on specific crash types. At signalized intersections, for example, the predominant crash risk is typically a rear-end type of crash, followed by angle and hit pedestrian crashes. Crash risk heat maps provide spatial and temporal details about

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specific types of crash risk, to assist in the diagnosis of safety issues at a particular location. Heat maps can also be weighted by Delta-V, providing a heat map that captures crash risk severity rather than just frequency. Crash risk heat maps derived from conflicts are one of several critical components for understanding risk at a monitored location.

Road user trajectories are also helpful for assessing and diagnosing safe operations of a site. The SAFETY trajectory dashboards allow users to examine the typical pathways or trajectories of road users, highlighting both usual and unusual paths. As an example, tracking bicycles and pedestrians through an intersection is insightful for assessing potential conflicts with other road users. Crossing paths of vehicles and bicyclists reveals potential conflict points, while pedestrians with consistent trajectories outside of marked crossings

pinpoints their spatial and risk exposure.

Obtaining operational examples of conflicts are useful for illustrating the nature of conflicts at a site, and are extremely beneficial for connecting computed risks with actual examples involving road users. The video clips provided are particularly useful for nonengineers and decisionmakers, who are often curious to know what 'risk' looks like in the everyday operation of a site. The video clips dashboard enables users to search examples of conflicts observed at monitored locations. Video clips are 'privatised' so that license plates and faces cannot be identified, with permission granted for their use by the data owners. Data privacy and security protocols are carefully managed to ensure that local, state, and national laws, procedures, guidelines, and policies of the client are satisfied.

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SMART SAFETY

Crash Forecasting

A powerful safety assessment tool is provided through the Crash Forecast dashboard. The ability to forecast crashes builds upon more than 70+ collective years of experience of the AMAG founders, and is a cornerstone module of SAFETY. It is important to recognise that crash data for a minimum of two or three sites in a region must be provided by the user in order to calibrate this module for local conditions. The calibration process also uses relationships obtained from AMAG's database (consisting of crash/conflict data from 23 + cities across 8 countries and more than 60 sites), and calibrates them to adapt crash forecasts to local conditions.

Crash forecasts provided by SAFETY include long-term annual averages, and should be interpreted as such. An average of 6.5 rear-end crashes, for example, might correspond with 9 crashes in year 1, 3 crashes in year 2, and
5 crashes in year 3. The utility
of crash forecasts provided
are derived from relative
comparisons within crash
types for a particular site,
and absolute comparisons to
other monitored locations.
Hourly crash risk forecasts are useful for relative comparisons to other, similar locations. SAFETY makes use of near-miss and interaction metrics that are related to crash severity, in addition to other operational conditions such as approach speeds, violations rates, and percentage of vulnerable

lourly probabilities for Minor injury

2 6 6 10 11 12 13 14 15 16 1 Host

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road users. Crash predictions by type of crash are also provided, yielding additional information about risk across monitored locations.



Benchmarking

Benchmarking is an integral part of safety management and essential to informing safety deficiencies and improvement. SAFETY relies extensively on the use of benchmarking to inform the risk and safety of a site. The Benchmarking dashboards allow users to select a set of comparison sites from all monitored locations. SAFETY allows comparisons across flows (for exposure), crash predictions (type and severity), road-user conflict intensity index, conflict distributions, and conflicts corrected for road user exposure. The benchmarks can then be used to compare the safety performance by

time of day, day of week, and with focus on specific road users. These comparisons are extremely informative for identifying outlying riskrelated attributes across a sample of monitored sites.





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Conflict Ra	ate Per 1	1000 Road Us	sers			The states		Table Tolday					
Site	0-Tum	Hit-Parked-Car	Opposing Approaches	Head-On	Shared-Path	Pedestrian	Rear-End	Bicycle	Parallel-Lanes-Turning	Adjacent-Approaches	Side-Swipe	Off-Pati	
Before	0	0	10.7743	0	0	0.0451	7.7351	0.0129	0.0032	2.8717	0.8766		
After	0	0	9.8267	0	0	0.0296	5.4275	0	0	2.5626	0.6407		
Difference	0%	0%	-8.80%	0%	0%	-34.47%	-29.83%	-100.00%	-100.00%	-10.76%	-26.92%	0	
Conflict Co	ount												
Site	U-Tum	Hit-Parked-Car	Opposing-Approaches	Head-On	Shared-Path	Pedestrian	Rear-End	Bicycle	Parallel-Lanes-Turning	Adjacent-Approaches	Side-Swipe	Off-Pat	
Before	0	0	3343	0	0	14	2400	4	1	891	272		
After	0	0	2991	0	0	9	1652	0	02	780	195		
Difference	0%	0%	-10.53%	0%	0%	-35.71%	-31.17%	-100.00%	-100.00%	-12.46%	-28.31%	0	



SMART SAFETY

Evaluation

Evaluation of countermeasures implemented to improve safety is vital to reaching Vision Zero goals. The expected reductions in crashes associated with a contemplated countermeasure are needed to assess which countermeasure provides the most benefit for available funds. Furthermore, some countermeasures may

improve safety for some crash types while increasing expected crash rates for other crash types. Traditionally, this knowledge was based on crash records and required waiting years for crash data to accrue. SAFETY allows for quick evaluations using conflicts which the research has proven are predictive of crashes. SAFETY provides functionality for conducting both before-after and withwithout evaluations and allows for comparisons across flows (for exposure), roaduser conflict intensity index, the number of conflicts and conflict rates by type and conflict distributions. A limitless number of site can be aggregated together for evaluation, providing for precise estimates with high confidence.

SMART SAFETY Countermeasures

Another distinguishing feature of SAFETY is an expert system that relates a site risk profile obtained from the SAFETY analysis with a list of potential countermeasures for the site. This expert system builds on the expertise of the AMAG team and their experience in diagnosing safety issues at transport network locations. The output of the Countermeasures Dashboard is a candidate list of potential rectifications that can be considered further for more detailed engineering studies and evaluation. The user is taken through a set of interview questions to help narrow in on potential and appropriate countermeasures. The interview tool is iterative, with answers to interview questions leading to different sets of recommended countermeasures.

The unique, tested, and validated dashboards provided by SMART SAFETY provide a comprehensive assessment of site safety that can be used to justify the expenditure of public funds on improvements, and to ensure maximum return on these investments. Importantly, investments to improve sites can be made prior to waiting for crashes to occur.



Report Generation, Help, and Feedback

SMART SAFETY is intended to provide users with the ability to explore, examine, and document crash risks both spatially and temporally at transport network locations. To save the results of an analysis, export results for further study, or share findings with colleagues and supervisors, SMART SAFETY contains a host of extensive report generating features. The report manager is where a user can access reports that are generated using SMART SAFETY. All dashboards have an ability to 'push' output to a report, and multiple reports can be generated at any one time. Report generation is seamless with the "add to report" feature available in every dashboard, and reports can be shared with colleagues, printed, edited, or deleted.

SMART SAFETY also contains user feedback and help functions to further support efficient use of the platform. A feedback function allows users to report on desired features, functionality, or noted bugs. A searchable help function allows users to seek support on any aspect of the platform, including technical terms, dashboard features, and fundamental operation aspects.

SMART SAFETY is a userfriendly, highly technical, and robust platform for assessing site-level and network safety using the benchmarking functions. It is designed to empower users to proactively assess road safety at monitored high-use locations on a network and to evaluate the success of applied countermeasures. It is a market-leading platform with respect to functionality and features, designed by internationally recognised road safety experts and built by world leading SaaS developers.



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SMART Video Analytics Products Use-Cases

Use Cases for across the Transport Enterprise	SAF	OPS	SUR
Accurate ID and tracking of multiple road users	0	0	0
Flow and turning movement by road user class	0	0	0
Treatment evaluations (before/after & with/without)	0		
Alert-based operations and risk reporting		0	
Continuous, real-time operations and risk monitoring		0	
Travel demand screen-line calibration support			0
Intersection and corridor modelling support			0
Blackspot evaluation and management	0		
Complex site operational and risk assessments	0	ο	
Speed studies and assessments		ο	0
Incident detection and management		ο	
Risk and operational diagnosis and countermeasure ID	0		
Asset inventory and condition assessment			
Pavement condition typology and assessment			

To book a demonstration of the Enterprise SMART SaaS Platform please go to our website **www.amagroup.io**

Advanced Mobility Analytics Group Pty Ltd (AMAG) aims to be the world leading provider for proactive Transport analytics and management, applying more than 70+ years of cumulative road safety knowledge to develop the only complete Transport management suite of modules from Safety, Operations through to Infra-structure. Using Video Analytics, Artificial Intelligence (AI), Deep Learning, and Advanced Econometrics, AMAG has solved the challenge of predictive analytics for road safety, and during the past decade the founders have proven the methodology and technology through research, refinement, testing, and validation with 23 cities across 8 countries.

AMAG is focused on what we do best, road operational and safety insights through the best analytics solu-tions, developed by the best people. To deliver the best end-to-end SaaS Solution to road safety practitioners, we are partnering with the absolute best technology providers and engineering consultancy service providers across the globe.

Find out more https://amagroup.io

