PRACTICALITIES OF NOISE MEASUREMENT AT A MOTOR SPORT VENUE

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1 INTRODUCTION

The Motor sport industry generates a passionate worldwide following delivering a variety of participative and spectator driving events. Whilst noise is an intrinsic and exciting part of the overall experience for drivers, riders and spectators it can be a source of nuisance to nearby residential areas and other neighbouring sites.

Noise is a crucial part of the overall management task for Motorsport Venues, although for some it can greatly compromise the ability to generate sufficient income streams for commercial viability in the current economic climate. Each venue has to conduct the balancing act of trying satisfy their paying customers whilst complying with an agreed noise management plan from their local authority. Failure to comply in a satisfactory manner could mean further constraints to activities or a tough financial penalty. To further complicate proceedings each UK circuit has a completely different set of noise constraints placed upon them.

The majority of UK venues work hard to comply with MSA (British Motor Sports Association), FIA and ACU (Auto-Cycle Union Ltd), FIM event guidelines regarding static vehicle noise testing. Whilst this procedure has its place in any noise control plan, and is straightforward to implement, it has been demonstrated to suffer limitations when attempting to effectively screen all noisy vehicles. Given the complexities of determining the actual environmental noise emanating from venues many circuits have installed Drive-by and / or environmental noise monitors. Drive-by noise monitoring has provided a more realistic methodology for determining the actual maximum individual vehicle noise level produced during typical participation in circuit activities. The main confusion here is that there is no specific legislation regarding the correct procedure for performing drive-by noise tests. Environmental noise monitoring, with monitors placed near a sensitive residential zone, has also proved an effective tool at a number of circuits.

This paper outlines the impact noise management has on the business model of permanent UK motor sport venues and the practicalities of implementing a continual noise management program.

2 HOW NOISE ISSUES INFLUENCE VENUE MANAGEMENT

A motor sports venue is like any other business, it has to create and maintain a successful and evolving business plan. The viability of the venue depends on the revenue generated through the range and number of activities and events that can be offered throughout the year, many of which have the potential to create an environmental noise issue for nearby residents. Events are categorised according to their potential to cause a noise problem and then venues are limited to the number of each classification of noisier events they can offer each year.

Clearly any permanent motor sports venue can create significant revenue and interest for an area through spectators taking advantage of local amenities. Some venues will have existed and developed with limited or no planning restrictions, other newer venues will not have this luxury.

Along with the environmental noise impact all circuits should also ensure they carry out regular noise at work risk assessments to ensure compliance with the latest Health & Safety law, thus minimising the risk of any worker suffering any form of noise induced hearing loss as a result of their work at the venue.

2.1 THE IMPLEMENTATION OF A NOISE MANAGEMENT PLAN

The local authority for each venue has to balance the business needs of each venue against the concerns of local residents by placing suitable limits and constraints in the form of a structured noise management plan. This plan should avoid any unreasonable restrictions to the venue's activities, whilst attempting to minimise any nuisance from noise. Compliance to the plan is essential or further restrictions to activities, financial penalties or even closure of the venue are all measures that may be sanctioned. Balancing the needs of all parties is a delicate and highly emotive issue.

2.2 PLANNING AHEAD

A key task for circuit managers is the planning of their annual calendar around the predicted noise category of each activity or event and it's associated noise-based constraints. This plan would then be submitted to their local authority for approval. The constraints placed will vary greatly from one circuit to another and is the subject of great confusion within the industry.

3 TYPICAL NOISE BASED CONSTRAINTS

Due to the fact that environmental noise and noise nuisance can be so subjective it is incredibly difficult to decide what is reasonable. Ultimately each local authority will have their own experts in this field and they will decide the level of constraints to be mandated. There are a number of ways noise is controlled at venues:

3.2.1 TYPICAL CIRCUIT ACTIVITIES

A wide range of activities is available across the UK's Motorsport venues and each has a different set of noise issues and is categorised accordingly from a noise aspect, these typically include:
Race meetings i.e. British Touring Car Championship, British F3 Championship, British Autotest Championship, Historic Vehicle etc.
Track Days or Experience Days allow members of the public to drive their own vehicles or an aspirational performance car around the circuit for a number of laps without competing. Given the tight speed restrictions on the UK highways this proving increasingly popular.
Vehicle Testing is the use of the track by any type of vehicles for the purposes of performance improvement of both the vehicle and driver / rider.
Corporate, Training and Retail events

There are also a range of 'specialist' circuits offering Hill Climb, Drag Racing and British Rally Cross events.

For example, historic vehicle events can often increase the likelihood of noise nuisance due to public perception and the specific noise character of vehicles designed before modern noise compliances were required.

3.2.2 CLASSIFICATION OF DAY TYPES

Local authorities have different ways of classifying each day at a circuit some examples are shown below. Days are categorised with each having a strict 'static' and / or 'drive-by' / 'environmental' noise limit. This element is crucial to the overall planning and management for each venue. Each venue is allowed a certain number of each classification or category of days per year. The rest of the days are quiet days where only lower levels of pre-specified noise are permitted. There can be a number of days, for example six, where there are no noise limits, and these are saved for lucrative prestige race events.

Example 1 UK Venue 1 hour L_{Aeq}
Category 1-day 63dB(A), Category 2-day 58dB(A),Category 3-day 45dB(A) - effectively a Quiet Day.
Each category is based around the highest Environmental 1 hours L_{Aeq} at a sensitive residential property.

3.2.3 OPERATING HOURS

Example:
No vehicle movements on the race track (including practice, testing, qualifying and racing)

Fridays, Saturdays and Bank Holidays	09:00 to 18:30
Sundays	10:00 to 18:00

No evening events shall take place on Fridays, Saturdays or Sundays.

3.3.4 NUMBER OF NOISY DAYS IN A GIVEN PERIOD

Example 1
Maximum limit of 3 noisy (Category 1 or Category 2 days) within each rolling 7 day period.

Example 2
Introduce a minimum number of Quiet days during weekend periods during the racing season

Example 3
Following a major event there will be a number of consecutive days of Quiet Activity and no evening events. This number will be based on the overall disruption to local residents (which may not just include noise issues).

4 NOISE MEASUREMENT OPTIONS

4.1 STATIC NOISE TESTING

Virtually every circuit in the UK operates a static noise test of every vehicle to MSA or ACU event guidelines prior to participation on the circuit itself.

Advantages:

- Minimum investment in noise instrumentation – simple sound level meter (non integrating) measuring Maximum Sound Pressure Level L_{AFmax} or L_{ASmax}
- Has its place in any circuits noise control plan
- Will quickly identify any problem vehicles before they go out on the circuit.
- Simple test that competitors and the general public understand

The instrument used should have calibration certificates and be field calibrated with an Acoustic Calibrator prior to each measurement session.
Once each vehicle is tested a sticker is placed on the vehicle to show it is ready to go onto the circuit.

Limitations of Static Testing

- Static 'Snap Shot' of stationary vehicle noise
- Various methods of cheating to pass the test
- Doesn't check tyre noise / driver style / gear changes
- Individuals can pass the Static test and then remove silencers / modify the vehicle before racing
- Rear engined vehicles may fail static testing whilst being amongst the quietest on the track

4.2 DRIVE-BY NOISE TESTING

The Drive-by unit, having a dedicated Class 1 automated self-calibrating weatherproof microphone assembly and electronics is normally placed a fixed distance i.e. 20metres from the centre of the track at a point on the circuit where the vehicle is at maximum acceleration and at a speed greater than 60 m.p.h. Drive-by systems will usually be used in conjunction with a time / date stamped video monitoring system keeping a record of the track activity.

Advantages of Drive-by testing

- Accurate representation of the noise of a vehicle and driver on the track
- Improved noise management can enhance commercial opportunities in the medium and long term.

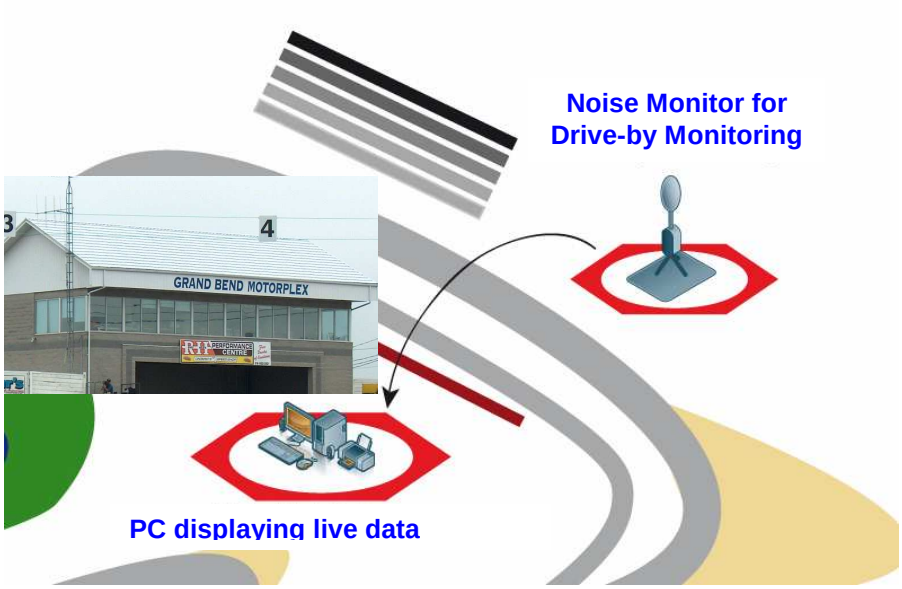
Disadvantages

- Comprehensive preliminary noise assessment required to determine the best position for the monitor and the effect of predetermined Drive-by levels at neighbouring properties

- Needs staff to monitor the noise levels whilst activities / events are happening.

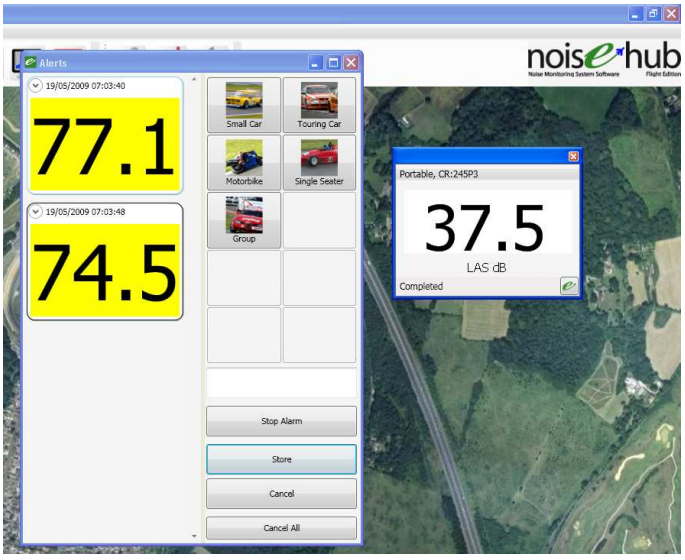
4.2.1 LIVE DRIVE-BY INSTANTANEOUS SOUND PRESSURE LEVEL MEASUREMENT

The drive-by system works best when the noise-monitoring device is sending out live data directly to a computer in the control tower or other surveillance point. The only practical methods to achieve this are by direct line connection or radio modem. Both communication methods are relatively costly to install but give free connectivity thereafter.



Advantages

- Immediate remedial action can then be taken to bring in any vehicle exceeding 'Drive-by' noise limits before any nuisance is actually created
- Controlling the noise problem at source
- Live identification of loud noise sources for subsequent reporting purposes



Disadvantages

- Need to classify and correlate exceedence data for some events

Often a full list / report detailing any occurrence of an exceedences along with the time and level of the exceedences must be submitted on a regular basis for local authority records.

4.2.2 PERIODIC L_{Aeq}(AVERAGE) NOISE LEVELS

Another popular methodology is to use periodic L_{Aeq}, average noise level, for periods of 30 minutes or 1 hour.

Advantages

- A metric recognised and widely used by local authorities
- Less surveillance required, no requirement to monitor individual vehicles
- Easier to report

Disadvantages

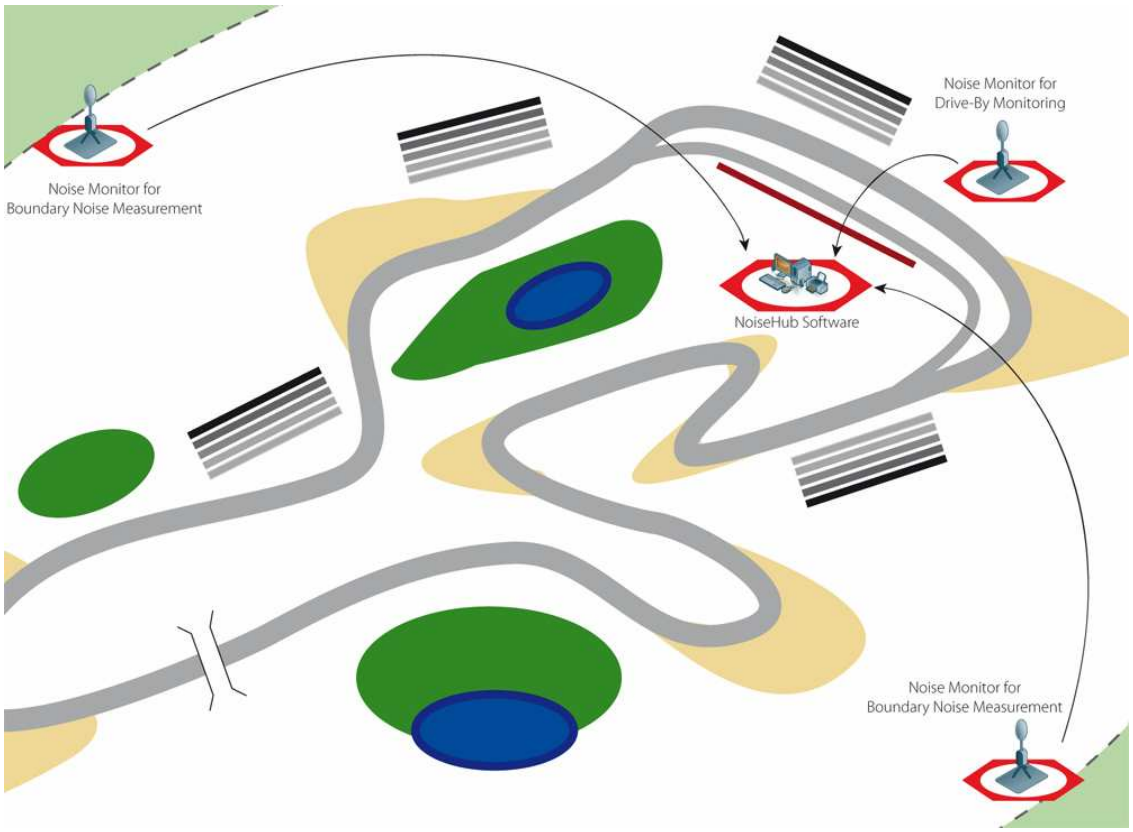
- One vehicle being tested with large amounts of down time would not cause issues with an average periodic L_{Aeq} but would be likely to cause complaints
- Other noise events can distort the periodic value
- Does not highlight individually noisy vehicles
- May have to stop latter stages of a session once the cumulative L_{Aeq} is getting close to the permitted levels causing frustration for drivers on the track who may not be responsible for the non compliant noise level.

4.2.3 PERIMETER / BOUNDARY ENVIRONMENTAL TESTING

Another method used is to measure periodic noise levels at the boundary or sensitive residential areas where the L_{Aeq}, statistical values such as the L_{90} are reported on a continuous hourly or half hourly basis. Once again the noise monitor needs to be a weatherproofed Class 1 system and ideally with remote communication. This allows the impact of specific events to be determined by comparison with typical quiet days. This method is usually used in conjunction with static and sometimes drive-by testing and attempts to examine the environmental noise impact on local residents. These systems may be transmitting live data but usually it is sufficient to be able to achieve remote access via GSM or GPRS modem.

Advantages

- Attempt to regulate noise levels close to sensitive properties
- Residents can see tangible evidence of noise monitoring
- Standard environmental noise measurement practice
- Accurate assessment of the impact of motor sport noise on the neighbouring environment



Disadvantages

- Less effective for quieter category days (other external noise sources can easily influence noise levels)
- Non compliance is only learnt about after the occurrence unless the monitors transmit live predictive periodic L_{Aeq} values
- Could be misleading if not used in conjunction with drive-by monitors

5 ACTIVITIES TO REDUCE THE IMPACT OF NOISE ON NEARBY RESIDENTS

Any new circuit can be located and designed with the potential noise impact in mind, however most UK circuits are built on existing disused aerodromes or ex MOD sites. Whilst these sites were usually located away from residential areas when they were originally built developers will build wherever they can gain permission. There are different ways a venue can work to reduce their noise impact on the local community, these vary from live noise level monitoring, liasing with local public groups and introducing a variety of noise reduction measures.

5.1.1 ADHERE TO THE NOISE PLAN

By carefully following the agreed noise plan and submitting clear noise measurement and exceedence reports, as requested, to the local authority will demonstrate the venue's commitment to noise management.

5.2 COMMUNICATION

Good communications with local authorities and residents certainly helps reduce the amount of annoyance and the number of complaints. Making local residents aware of the noise control measures that are put in place and giving the public access to a 'Noise Diary' of forthcoming events and their respective predicted noise category via a special section on the venue's website can help.

A 'Noise Telephone Hotline' provides residents with the facility to immediately alert the venue should the noise levels become troublesome.

By issuing free event tickets to neighbouring residents a better relationship will be created because even if they don't like motor sport they will enjoy passing them on to other family members or friends.

5.3 NOISE CONTROL TECHNIQUES

There are many techniques available for reducing noise such as the initial circuit design, acoustic barriers (including planting trees), placing the paddock away from residential areas, choosing a quiet track surface, using quieter and regularly maintained vehicles for training or experience events, limit the number of vehicles allowed on the circuit at any one time etc. Many venues offer a choice of circuits for differing activities and these often combine to form an overall Circuit. Often some of the smaller internal circuits are further away from sensitive residential areas and are utilised to reduce the noise impact.

6 CONCLUSIONS

Communication seems to be a key issue to the effective management of Motor sport venue noise and this starts with the venue's local authority. Meetings with local resident groups in conjunction with focused website information and a telephone hotline maintain an ongoing dialogue and increasing good will between the venue and members of the public.

Implementing a Noise Management Plan requires an initial financial investment for consultancy services, noise monitoring instrumentation, video equipment, staff training and customer awareness training. There are the ongoing costs for staff to carry out static testing and the control of live Drive-by monitor data, annual calibration of noise measurement instrumentation and regular noise measurement reporting and archiving tasks.

Each venue will gradually become more experienced in recognising potential noise issues and developing their own best practice strategies to control them. Examples here include:

- Limiting the amount of vehicles on the track at any one time for specific activities
- Recognising when weather conditions are likely to exacerbate environmental noise issues
- For some activities using internal sub circuits to shield (through natural topography) or move the noise further away from residents.
- Selecting a fleet of relatively quieter and regularly maintained cars for driving training or experience days.

Given the crucial importance of noise management to the successful operation of motor sport venues the whole issue of governing the management of environmental noise is treated very differently depending the local authority involved. Most Motor sports venues would welcome more clarity and guidance regarding global best practices and noise measurement methods to minimise their noise impact whilst increasing the quantity of products / events they can offer each year.