

# Managing risk in acoustics: The role of a consulting professional

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## ABSTRACT

Poorly implemented or unsatisfactory acoustic design can be very difficult and expensive to remedy. Accordingly, acoustic treatments are typically most cost effective when they form the part of an integrated design solution rather than applied as remedial fixes. This paper firstly presents a discussion of the basic information that should be considered in scoping or briefing projects. Secondly, the designer's obligation to ensure treatments and associated performance metrics are clearly articulated and understood is explored with emphasis on the importance of co-ordination for an integrated design. Here the question is posed, how does one effectively communicate expected outcomes, quality and risk to designers and stakeholders? Particularly given that such information is of critical importance in empowering clients to make decisions around risk and cost. In addition, suggestions and guidance are provided relating to other factors that influence the successful delivery of a project. Finally, this paper seeks to share this knowledge with the aim to improve the consistency and quality of acoustic advice provided within the consulting industry.

## 1. INTRODUCTION

Acoustics is often perceived as a 'dark art' by non-acousticians. Stakeholders and clients may not readily understand acoustic terminology, and the associated workings and methodologies applied may appear unusual to those not familiar with these processes. In many instances the client is only interested in the result, and provided this is workable may have no further interest in understanding how the findings were determined.

The challenge is how do consulting acousticians better engage with clients to empower them to own and manage decisions relating to acoustics where these may have a degree of risk associated? This issue is particularly important where the client is seeking to value manage the cost of acoustic treatment on their project.

This paper presents a discussion of factors that can influence the successful delivery of acoustic services on a project. It is hoped that the ideas presented in this paper will be a useful introduction to young practitioners starting a career in acoustics.

## 2. UNDERSTANDING THE BRIEF – AGREEING ON SCOPE AND METHODOLOGY

From the outset of a project it is important that consultant and client have the same understanding of the project requirements. The basis of the common understanding is used to define the scope of works for the project. This can be challenging for clients as they may not always be familiar with the process or issues when it comes to acoustics. Ideally, a consultant will engage with the client at this point to tease out their requirements and use this information to define a clear scope of works outlining the tasks, actions and outcomes required. However, in many instances the client may have already defined their scope and objectives and the consultant must respond to these.

What can make this challenging is that acoustic services may not be engaged directly to the end client (the one ultimately paying for the project). Instead it is common for acoustic services to be engaged via an intermediary such as an architect, managing contractor, or an engineering consultancy. These parties may have obligations back to the end client and it is often useful to determine any acoustic objectives that must be satisfied by the overarching project brief. Such information is useful to ensure that the proposed scope aligns with the end client's expectations and effectively manages the risk for the direct client.

The level of detail within the scope will normally depend on the complexity of the project and the associated risks. A well-defined and clearly articulated scope helps ensure the client gets what they want and ensures the consultant understands their role and responsibilities on the project. In some instances it may be necessary to help the client recognise any limitations with base scope and provide options for more detailed assessment where they may be beneficial.

It is often necessary to respond to the anticipated delivery methodology including the staging of key milestones so that it is clear to all parties what information will be provided and when.

Furthermore it is useful to define any required inputs or information that may be necessary to deliver the scope. This will help manage issues where this information may not be readily available or there is a significant cost

involved in sourcing such information. It is also often useful to agree on the timing of key deliverables or conversely inputs where the successful delivery of the project may be contingent on these.

Ultimately all this information will feed into an agreement which is used to define the contractual obligations between the client and consultant. Defining and understanding these obligations helps manage the risk to both parties and is critical to the successful delivery of the project.

### **3. COMMUNICATING ACOUSTIC REQUIREMENTS AND OUTCOMES**

As described in the introduction, the terminology and methodologies applied in acoustics are not always easy to follow for non-technical persons who are unfamiliar with these. The way in which information is communicated to clients and stakeholders can have a significant influence on the successful management of risk and application of any treatments or mitigation measured.

#### **3.1 Understanding the audience**

Results, requirements and outcomes are typically communicated by way of short written reports or briefing documents. These documents are written for a specific audience to communicate key ideas and information. Before writing the report it is useful to understand the purpose of the report as well as the intended audience. Recognition of the intended audience and how the report will be received should significantly influence the style in which the report is written. It is not unusual for a report written for a particular audience to then be repurposed or used to brief other stakeholders. For consultants it can be difficult to strike a balance between a report that outlines key assumptions and technical aspects which influence the outcomes versus one that can be easily understood by laypeople or other stakeholders with less background in acoustics. It is the view of the author that it can be beneficial to clarify the audience and the purpose of the report as part of an introduction. It may be useful to clarify this within the initial scope as well.

#### **3.2 Balancing the level of detail communicated**

Noise and acoustic issues are inherently complex and not necessarily intuitive. It is not unusual for acoustics to be referred to as 'black magic' or 'smoke and mirrors'. The goal of a consulting acoustician is to ensure the client understands enough detail to manage the risks as required. Accordingly a report may seek to simplify the issues/items down to make them easier to digest for lay people and stakeholders. Provide too much detail or information and you could find that interested parties quickly get out of their depth technically.

It is necessary that the client appreciates the implications of key assumptions and any associated limitations within an assessment. The client must be informed sufficiently to empower them to balance and negotiate the associated risk for themselves. Consultants can assist clients in understanding and managing/mitigating these risks, however, inherently the risk may not be the consultant's to own.

In particular it is useful to qualify the results of early assessments to help clients understand the accuracy of the assessment and factors which may ultimately impact on the final result. Where the client accepts a more risky approach or methodology, do they recognise the limitations associated with the assessment? It may be appropriate to make clients aware of the tolerances and uncertainties involved in achieving a given outcome. In some instances it may be useful to communicate likely remedial treatments should compliance not be achieved. Such information may be useful to help clients better understand and manage their risk exposure.

Do the stakeholder expectations match reality and what can practically be achieved? Is there a need to seek dispensation or communicate these issues to the client or stakeholders in seeking a relaxation from the brief? These issues can be important considerations in moderating the expectations of the parties involved.

#### **3.3 Co-ordination with other design disciplines**

Acoustics is somewhat different to other design services in that the final treatments typically need to be captured in the documentation of other consultants/designers. Accordingly on more complex projects it is important to coordinate with the design team to ensure the design intent is understood and documented. Where the requirements are onerous or particularly critical to the result, it may be necessary to articulate the obligations of different parties within the brief or a specification for the project. For example, in recommending acoustic treatments to mitigate mechanical services noise or treatments that will influence airflow through a building or to a plant item, a recommendation to seek review and input from the mechanical services engineer should also be made.

As part of the co-ordination process, it may become apparent that the proposed treatments are too costly, not entirely practical or the desired outcomes may not be readily achievable. The process may highlight that the way the information or requirements have been communicated means that these are not easily understood or able to be verified by non-acousticians such as contractors or other design disciplines.

Not only does co-ordination better manage the risk for the client, it also helps inform consulting acousticians of the practicalities of the treatments they recommend. These learnings can help improve the design and can then be applied to the next project or problem to provide more robust or cost-effective solutions for the next client. Ultimately, co-ordination assists in delivering an integrated design that satisfies the needs of the client.

### **3.4 The use of appropriate metrics and descriptors**

It is important that all requirements are communicated in a way they can be clearly understood and verified by those responsible for meeting or maintaining these.

Consulting acousticians need to consider what data is typically available for designers, tenderers and suppliers to work with. There is little point in communicating highly detailed or complex requirements where these parties are unable to resolve the acoustic requirements. Indeed, such an approach may actually result in more risk for the client or contractor even if the consultant has covered their own risk exposure.

Many single-number weighted metrics have been traditionally developed to consider factors that influence annoyance or complaint; however they may not accurately represent all situations or scenarios. Accordingly, the metrics utilised in the acoustic report need to acknowledge the criticality of the outcome. For a performance venue it may be necessary to specify acoustic requirements in octave band values for example. However for less critical developments a single-number weighted metric may be sufficient.

### **3.5 Alternative means of communicating results**

Written reports and briefing documents are normally used to inform stakeholders of the expected/intended outcomes. Unfortunately, many of the terms and metrics that used to describe sound and noise are not directly relatable to lay people and other stakeholders. This can be challenging where there are issues or significant cost involved in meeting the brief and it becomes necessary to help the relevant parties understand the implications of these issues to determine the best way forward. In situations like these it may be necessary to use tools and props to assist the stakeholders in understanding the proposed outcome or result.

Auralisations and acoustic simulations can be of great value in communicating outcomes in a way in which an average non-technical person can better comprehend in terms of the end result or difference between alternative schemes. However, a degree of caution should be applied in using auralisations and it is necessary to highlight that these are approximations and the end result may sound somewhat different in reality. Additionally, listening to a simulation through speakers or headphones in a controlled room may make a different impression than experiencing the outcome in the real world where context can be an important factor.

Another simple tool that can assist stakeholders in better understanding the resultant noise level is a 'noise thermometer'. An example is provided in Figure 1. The term alone is enough to cause anxiety with the more pedantic of acoustic consultants, as you cannot measure noise with a thermometer! However, as a tool, nothing is as simple or effective in helping people rank a noise outcome against every day noise sources or scenarios, which they are already familiar with. Terminology aside, a noise thermometer is a great tool for engaging with lay people to help them understand the context of the forecast level. As acousticians it is useful to acknowledge that these tools or props may not always be technically accurate, however they are simple to understand which makes them invaluable.

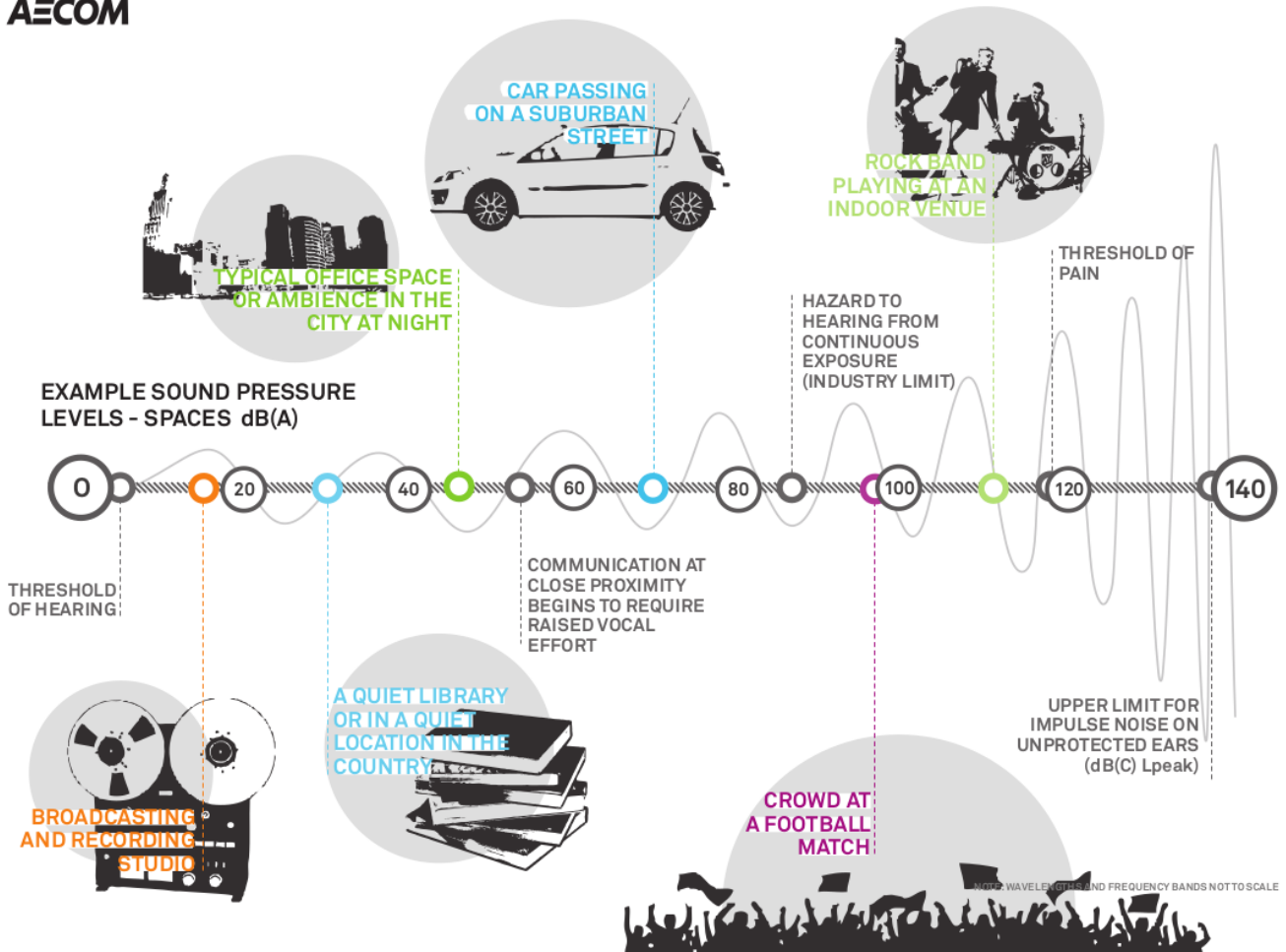


Figure 1: Example of a 'noise thermometer'

#### 4. OTHER FACTORS INFLUENCING ACOUSTIC OUTCOMES

Beyond the basic communication of information there are other factors that can influence the acoustic outcomes for a project. Some key factors are discussed below.

##### 4.1 Timeliness of advice

Early advice and guidance can greatly assist in avoiding common acoustic problems or issues. It is good practice to identify potential pinch points in the design early, so that guidance can be provided to the rest of the design team to assist in navigating these issues. Consequently this approach maximises the opportunity for workable solutions and minimises abortive design work by peer designers. Designers need to be cognisant of issues that may impact on their ability to satisfy the intended outcome. For less experienced practitioners it can be useful to identify and discuss such issues with a more experienced practitioner as part of an internal project approach review before starting the project.

It is often necessary to qualify the basis of any early advice, particularly where the proposed approach may be contingent on factors not directly within the control of the consultant providing the advice. In summary, most acoustic problems or issues have solutions with practical limits to what can be achieved and it is early advice on these limits that typically offers the greatest value. Early advice is also often beneficial for clients as it allows them to apportion indicative cost budgets to acoustic treatments.

##### 4.2 High level checks and rules of thumb

A lot of acoustic issues or relationships can be addressed using high level checks or rules of thumb. However, the limits of these rules are not often understood and accordingly these rules may be applied to instances where

they do not hold true. Less experienced practitioners in particular need to be careful and apply appropriate qualifications around these.

### **4.3 Sensitivity analysis**

Modern noise modelling software allows practitioners to assess large or complex acoustic problems quickly and efficiently. This introduces its own challenge, as many practitioners may be tempted to utilise modelling software as a black box, where inputs are arbitrarily entered to determine an output. Such modelling software often incorporates many variables and parameters that are pre-set to default values such that the user may not bear thought for their influence over the outcome or even their existence.

Not only does such an approach create significant risk, it limits the ability of designers to improve their understanding of the factors influencing the end result.

To better understand the factors at play it can be useful to create simple reference models, where fundamental assumptions can be varied to ascertain their influence. Alternatively, that same approach can be applied to the main model to conduct a sensitivity analysis around key assumptions and inputs.

Acoustic measurements can also be useful to verify the accuracy of a model and assist in assessing the impact particular assumptions may have on the result.

The above considerations can be useful to improve a consulting professionals understanding the potential risk associated with different assumptions. This approach allows designers to focus on managing key risks or issues which have the most impact on the design, allowing some flexibility to less critical factors.

### **4.4 Consistency of outcome**

The application of prescribed assessment methodologies and guidance within policy and legislation is used to maintain a degree of consistency around the assessment outcome. Further to this some authorities require that suitably qualified persons undertake assessments. The expectation is that these persons have sufficient education and experience to manage the risks associated with the application of legislation and standards.

However, it is noteworthy that there may be a degree of interpretation associated with the application of standards in particular. Individual practitioners may apply the same standard somewhat differently.

Guidelines or methodology documents from regulatory authorities may assist in clarifying how the standard or legislation is intended to be interpreted and the outcome to be delivered. In the absence of such information, in Australia the Association of Australian Acoustical Consultants (AAAC) has released a number of guidelines which seek to provide a degree of consistency in assessment across the industry. Other countries may have similar industry bodies that promote the standardisation of processes for acoustical assessments.

Furthermore, the use of empirical evidence such as in-situ measurements, sample testing or testing of mock-ups can be useful for assessing the accuracy of an assessment methodology.

### **4.5 Designing for strict compliance**

There are numerous factors that influence whether a modelled result matches reality. A noise model might show full compliance with criteria, however in reality there are some locations where the level will be higher and some locations where it will be lower. Acoustic practitioners need to acknowledge that there is float within the modelling process and associated inputs and assumptions and manage this as appropriate.

In particular legislation may require the application of a simplified modelling algorithm to assess complex problems and there may be factors not considered within the model that influence the end result. For example many noise models used to assess transportation noise do not consider meteorological conditions as it is assumed that noise emission to nearest receivers is not influenced by these effects.

Where a client or a stakeholder has a clear expectation that full compliance must be achieved it may be necessary to clarify the specific conditions under which compliance will be satisfied. A practitioner may also consider implementing safety factors to ensure the necessary outcome is met with an agreed level of certainty. Such safety factors should consider potential variations that may occur due to known factors. Alternatively they may be based on statistical metrics derived from the distribution of results to maintain a particular confidence interval or compliance, for example within one standard deviation.

### **4.6 Quality assurance and verification**

There is value in getting work reviewed or checked by peers to verify that it is ready for issue and does not contain any obvious errors or omissions. In many instances such reviews and checking is a requirement of internal

quality assurance systems and processes, such as those required for ISO 9001 Quality Management certification (International Organization for Standardization 2015). Such systems may also incorporate pre-start planning and approach reviews to ensure that participants are on the right track from the start and are able to execute the project effectively and efficiently.

In completing a review a key question that must be resolved is, does the review and checking reflect the associated risk? Equally, the review must consider whether the work meets the agreed scope and the client's need.

For simple low risk projects, the review may be limited to checking of the final deliverable and confirmation that the proposed treatments are consistent and reasonable. For projects with large noise models, review and checking may extend to the modelling inputs and approach also. In these cases, modelling checklists can be useful in confirming that both model author and reviewer are in agreement of key modelling inputs and assumptions.

It is recommended that noise models and associated workings are clearly annotated and labelled to assist with review and checking. Is the process that has been taken in arriving at a solution clear to the reviewer?

## 5. CONCLUSIONS

This paper presents a summary of factors that may influence the successful delivery of acoustic services on a project. The fundamental basis of any project starts with understanding the brief and agreeing the scope and methodology. This information will in turn be used to define the contractual obligations of the parties involved.

The next most influential factor is the communication of information to the client and stakeholders. Acoustic requirements and outcomes need to be clearly articulated to those responsible for managing or understanding these.

Other factors that influence acoustic outcomes include the timeliness of the advice, the methodology applied to determine the outcome, as well as the quality assurance and verification applied in delivering the project. This paper does not seek to provide an exhaustive discussion of these items, merely introduce these key concepts for consideration of acoustic practitioners.

## REFERENCES

- International Organization for Standardization 2015, *Quality management systems - Requirements*, ISO 9001:2015, International Organization for Standardization, Geneva.
- Association of Australian Acoustical Consultants 2014, 'DRAFT Licensed Premises Noise Assessment Technical Guideline' November 2014.
- Association of Australian Acoustical Consultants 2010, 'Guideline for Apartment and Townhouse Acoustic Rating', September 2010.
- Association of Australian Acoustical Consultants 2010, 'Guideline for Child Care Centre Acoustic Assessment', September 2010.
- Association of Australian Acoustical Consultants 2011, 'Guideline for Commercial Building Acoustics', May 2011.
- Association of Australian Acoustical Consultants 2010, 'Guideline for Educational Facilities Acoustics', September 2010.
- Association of Australian Acoustical Consultants 2010, 'Guideline for Report Writing', September 2010.