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RECENT ADVANCES IN SPEECH INTELLIGIBILITY AND SOUND SYSTEM DESIGN
Part II: OBJECTIVE MEASUREMENT TECHNIQUES

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ABSTRACT

After a brief review of the latest advances in speech intelligibility objective measurement techniques, this paper describes the methodology of analysis applied by the Authors using several of the established methods, including *ALcons, STI, RASTI, Articulation Index and modified-S/N*. Supplementary measurement techniques are also briefly discussed, including loudspeaker testing, frequency response, impulse response and reverberation time. Relevant features of A-CADI, a computer-assisted programme for the analysis of measured data are highlighted, the design details of which are described in Part 1 of this paper.

1. INTRODUCTION

Major advances in speech intelligibility analysis and measurement techniques have been recently reported in the literature. These advances have been realised through serious reasearch efforts by various workers in these disciplines, further to the availability of faster and cheaper microprocessor / microcomputer-based systems in both hardware and software. As a result, several manufacturers now provide a broad range of equipment which enables users to carry out quite sophisticated measurements in relation to most of the key parameters of sound reinforcement systems.

Unfortunately, controversy still persists over the "*applicability*" of several of these techniques, so that although the equipment is commercially available, users must still exercise caution in the interpretation of their measurements, and the confidence they derive therefrom.

This paper attempts to analyse the *application* of such objective measurement techniques from the *viewpoint of a user*, by offering suggested means of improving the accuracy of such methods in general. While the main emphasis is on speech intelligibility, aspects relating to other supplementary measurements are also briefly discussed.

2. REVIEW OF SPEECH INTELLIGIBILITY ANALYSIS TECHNIQUES

The main causes of reduced intelligibility are well recognised, as discussed by Davis [1], amongst others, including: poor *signal-to-noise* (S/N) ratio; excessive *reverberation*; long-delayed specular *echoes* (over 100ms); excessive *distance from the source; poor source directivity*; loudspeaker *mis-alignment* (between alike devices); *misequalisation*; and *distortion*.

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From a designer's *viewpoint* the main parameters are reverberation time (T), direct-to-reverberant ratio (D/R), S/N and relative echo level. The effects of T, D/R and S/N are now reasonably well-quantified, although some differences of opinion still exist, however comparatively far less progress has been made thusfar in relation to echoes [2].

Smith [3] gives a comprehensive description of the various methods of speech intelligibility analysis used at present, including articulation-loss of consonants, speech transmission index, articulation index and modified signal-to-noise. These methods are briefly described in the following subsections.

2.1 Articulation-Loss of Consonants (ALcons)

This method is attributed to Peutz [2], with various subsequent additions by other co-workers. It considers T, D/R and S/N, from which a % ALcons is derived, giving a measure of intelligibility performance. Maximum articulation loss values of 10-15% are normally aimed for, as suited to talker, listener and message characteristics. The analysis is nominally restricted to the 2kHz band, and makes no allowance in its direct field assessment for early reflections/contributions [4]. Furthermore, this method makes no special provisions for the consideration of specular echoes, although recent references to progress in this domain are noted [5-6].

ALcons applications in measurements include the recently released Time Energy Frequency (TEF) analyser by Techron [4]. Direct measurement of the key parameters, using other micro-computer based analysers, such as FFT may also be performed, with subsequent application of suitable formulae by the user in order to arrive at a %ALcons.

2.2 Speech Transmission Index (STI)

This method is attributed to Steeneken and Houtgast [7]. It is based upon the Modulation Transfer Function (MTF), which is mainly related to the Early Decay Time (EDT), with the added effect of noise being considered. The resulting index is in the range of 0-1, larger values indicating improved performance. Minimum index values of 0.52-0.45 are normally aimed for, which in fact correspond to the 10-15% stipulated for % ALcons, as described above. Conversion between STI and ALcons can be made based on the work of Becker [8]. The analysis should ideally be carried out over a wide band (e.g., 125Hz-to-8kHz), although a restricted band technique (e.g., RASTI) is sometimes carried out to limit measurement time [9]. The STI method makes no special provisions for the analysis of specular echoes as such, it does however have the capability of warning the user about problems that affect the accuracy of the measurement in this respect [10].

STI applications in measurements include the rapid speech transmission index (RASTI) by Bruel and Kjaer [10], and full-band STI analysis by the TEF [11]. FFT-based analysers with ancillary computing power are also capable of implementing the technique [12].

2.3 Articulation Index (AI)

This method is attributed to Kryter et al [13]. It is mainly suitable for noise-only cases, with analysis of S/N over the full-band. Index values are well established for different types of test material (PB-words, rhyming words, sentences...), and the end result is given in the form of % intelligibility as suited to the type of message being considered. Reverberation time may be taken into account to a certain extent [14], although this method is not particularly intended for reverberant systems.

The application of AI measurements is easily realisable with standard equipment, for noise-only cases [15].

2.4 Modified-S/N

This method is attributed to Lochner & Burger [16], with various subsequent additions by other workers in the field [17-18]. It considers the system square impulse response, which specifically caters for reverberation/echoes, with further provisions for the effect of noise if required. The analysis may be both wideband or narrowband, the latter being normally restricted to 1kHz [17]. The result is given in the form of a % intelligibility, rather similar to the AI method, as it essentially derives therefrom.

There is no established method at present for the application of this technique in practise, although its prospects appear very promising with the use of TEF/FFT/TDS [19]. Some recent studies by Bradley [18] show very good correlation through the application of proper integration time as compared with other methods, and it is expected that its application will be far more widespread in the near future.

3. PRACTICAL APPLICATIONS OF THE MAIN TECHNIQUES

It is clear from the above that users at present have a number of choices of commercially available equipment. It is not the intent here to offer any guidance on making such a selection, but rather to offer suggestions on means of improving the accuracy of such measurements whichever one is used. In this context, a good understanding of the limitations of each technique is thoroughly recommended, so that confidence limits are clearly appreciated by the user.

3.1 TEF/ALcons

Measurements of the key parameters of T and D/R are performed at 2kHz, using the TEF analyser. There is still some controversy as to the proper choice of integration time, which has a marked effect on D/R [4]. This also affects measurement of T, which is based on a reverse Schroeder integration, nominally defined for a 10dB decay (early decay time EDT) [4], or alternatively for the main decay slope. Peutz formulae for this analysis [2,4] may also be applied to take noise into account, and TEF gives the value of S/N for which a 10% ALcons is expected (assuming of course that the measured noise-free value is less than 10%). These formulae are specifically developed for values of D/R and T as measured by TEF [4], and it is probably safe to follow these guidelines in most applications.

The Authors did however experiment with a number of distributed systems operating in reverberant environments, for which integration times up to around 70ms were considered, with T being defined in the more traditional way [20]. Improved accuracy was indeed noted for integration times in the range 30-40ms with reverberant times over 2s, whereas values around 70ms were found to be more appropriate for lower reverberation times (1-1.5s).

It was concluded by the Authors that the shape and structure of the early decay curve appears to have a significant effect on the results, as does the linearity of the overall reverberation time characteristic. It would appear that the proper choice of integration time should be made accordingly, and no simple rule can be used. Effects of weighting in the frequency were briefly considered, but further investigation is needed, especially in cases where the conditions differ measurably across the bands of interest (say 0.5-4kHz). Otherwise, a 2kHz analysis is sufficient, and in some cases gave better results then a wider band analysis. It is not clear however whether a 1/1 or a 1/3 octave band analysis should be used, and the latter is normally selected, in keeping with established practise.

Suggestions for the consideration of users of TEF/ALcons are illustrated in Figure 1, and summarised as follow:

(a) make suitable *choice of integration time*, dependent on shape of ETC experienced, with allowance for early arrivals, as appropriate [20].

(b) note *specular echoes*, if any, as these are not explicitly considered in the derivation of %ALcons, this being a simple function of D/R and T, so that ALcons may be worse than actually predicted by TEF;

(c) perform *additional measurements in bands* other than the traditional 2kHz band, to obtain a full "picture" of prevailing conditions, such as 0.5, 1.0 and 4.0kHz, and apply weighting factors, if appropriate;

(d) perform ancillary measurements for assessment of *response quality, energy frequency curve* (EFC), *window analysis*, and so on, as required for problem areas being studied [20];

(e) perform *predictive intelligibility analysis* to consider effects of noise and/or reverberation expected to be encountered under untested conditions (such as presence of people, other sources of noise, and so on), in addition to listener auditory response and open microphone effects, as required [21, 23].

Results may be presented in the form of performance classification areas, such as "worst", "typical", and "best", with plots of expected %ALcons against the variable parameters of interest, as illustrated in Figure 1.

3.2 TEF/STI

The application of TEF/STI is relatively simple, to the extent that a user needs not consider any result other than the overall index. However, to obtain improved confidence in the results it is considered essential that the following be performed, as illustrated in Figure 2:

(a) study *MTF curves* for possible specular echoes, and perform supplementary ETC analysis as appropriate (check 0.5-16Hz modulation range) [10];

(b) check *deviation of EDT (Equiv-S/N) values* across the measurement bands, and consider effectiveness of the weighting factors used [11-12].

(c) perform ancillary measurements for assessment of *response quality, EFC, window analysis,* and so on, as required for problem areas being studied [20];

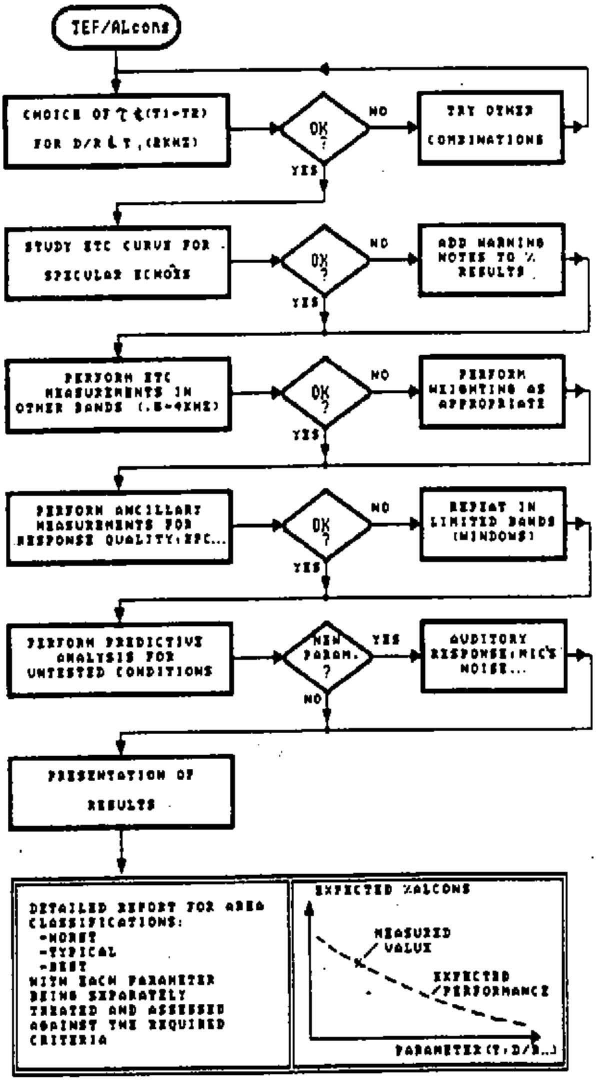

Fig. 1 Suggested Methodology for the Analysis of TEF/ALcons Measurements

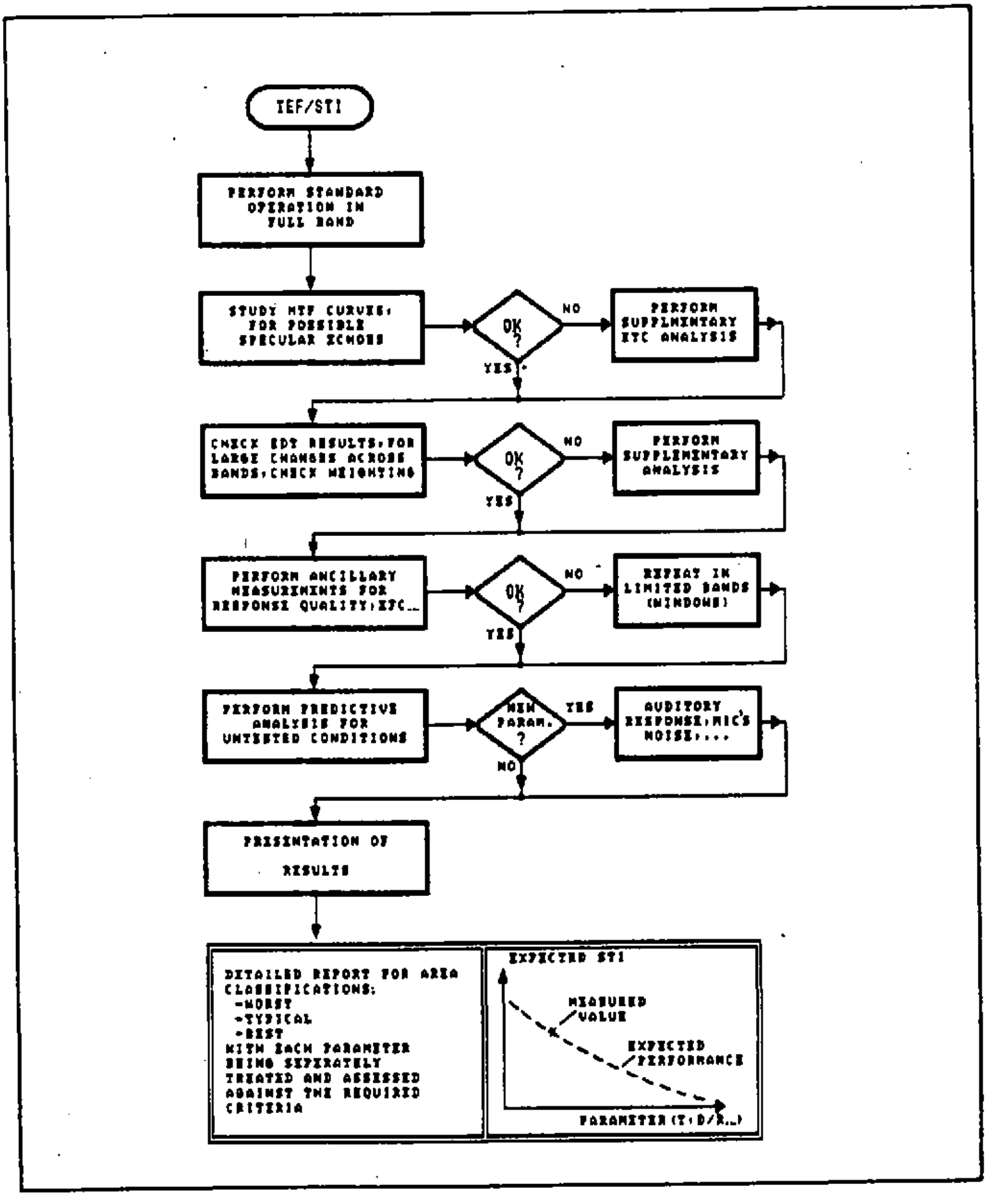

Fig. 2 Suggested Methodology for the Analysis of TEF/STI Measurements

(d) perform *predictive intelligibility analysis* [21,23] to consider effects of noise and/or reverberation expected to be encountered under untested conditions (such as presence of people, other sources of noise, and so on), in addition to listener auditory response and open microphone effects, as required.

As described above for TEF/ALcons, results may be presented for "worst", "typical" and "best" areas, with plots of STI against the variable parameters of interest, as illustrated in Figure 2.

3.3 RASTI

The application of RASTI (B&K) is relatively simple to the extent that a user needs not consider any parameter other than the overall index. However, to obtain improved confidence in the results it is considered essential that processing of other parameters be undertaken, in addition to ancillary measurements, as illustrated in Figure 3, and summarised below:

(a) perform *multi-records*, as necessary, to confirm repeatability of results within the expected confidence limits [10];

(b) analyse *m-reduction values* obtained (averaged as appropriate), with assessment of conditions relating to pure exponential decay, direct-field effects, and so on [21], with due care to the possible effect of specular echoes. Effectiveness of averaging the individual band STI values is also to be considered;

(c) perform ancillary measurements, such as frequency response variation with at least *1/3 octave analysis*, in addition to reverberation time/EDT characteristic over the speech bandwidth [20];

(d) perform *predictive intelligibility analysis* [21-23] to consider effects of noise and/or reverberation expected to be encountered under untested conditions (such as presence of people, other sources of noise, and so on), in addition to listener auditory response and open microphone effects, as required.

As discussed above for TEF/ALcons, results may be presented for "worst", "typical" and "best" areas, with plots of RASTI against the variable parameters of interest, as illustrated in Figure 3.

3.4 Modified-S/N (Impulse Response Analysis)

As described earlier, there is no standard set of equipment suited for such a measurement, so that users have to resort to impulse response measurements and analysis thereof, as appropriate.

The limitations of pistol-shot methods are obvious, and the promising deployment of TEF/FFT/TDS is yet to be practically realised in an integrated package giving the required % intelligibility. As the purpose of this paper is to discuss existing equipment, hence no further comments are included at this stage, except to emphasize the potential of this technique.

3.5 Articulation Index

As described earlier, this well-established method may be easily realised with standard equipment, and is included here for completeness only.

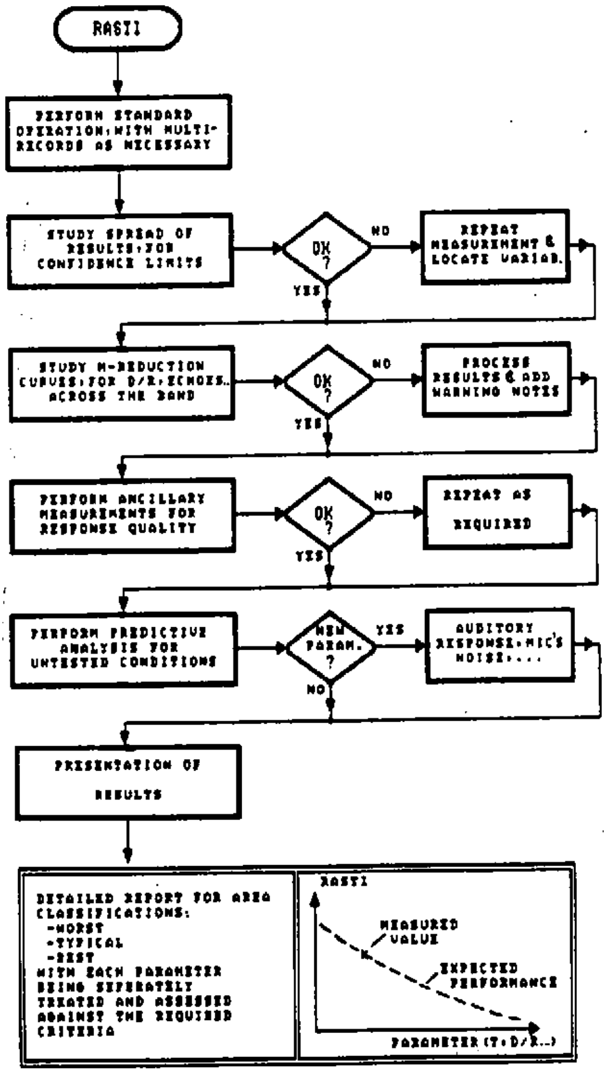

Fig. 3 Suggested Methodology for the Analysis of RASTI Measurements

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4. ANCILLARY MEASUREMENTS

In addition to the speech intelligibility analysis techniques discussed above, other supplementary measurements need to be carried out in certain cases, in order to form a complete "picture" of the system under test.

The first step is that of achieving an acceptable *uniformity of coverage*, with a *frequency response* within the performance criteria specified. This measurement may be achieved by using a real time analyser during the equalisation process, or by the use of a suitable sound level meter. Normally, 1/3 octave band analysis is performed.

If more detailed measurements are nedeeded in certain problem areas, and where a TEF/FFT analyser is available, it is possible to obtain *EFC's* further to carrying out *time-window test sweeps*. *Energy frequency time (EFT)* plots may also be obtained, combining frequency and time analyses onto a common set of co-ordinates, if required.

Reverberation time analysis is another important measurement, and several models of various equipment are now available for this purpose. Traditional cut-off decays may be obtained, in addition to impulse testing. Use of wideband test signals is now more widespread, such as frequency swept signals and pseudo-noise (maximum-length sequence) signals, which are also useful for carrying out analysis through the reinforcement system under test, where impulse techniques cannot really be applied. Analysis of the acoustical enclosure (with sound system off) is also useful, and here, bandpass impulse testing can be used, with special loudspeakers.

In cases where the performance of the actual loudspeakers of the system under test need to be measured, TEF may be used, providing *polar patterns and frequency responses*. This is particularly useful in checking multiway systems, and where loudspeakers are covered by materials for architectural aesthetic reasons, which will inevitably affect their performance [20].

Finally, the reinforcement system hardware may be checked for operating level and distortion, with due consideration to open microphones, so that the true overall system response may be tested.

It is also worth noting that the use of a *calibrated measuring microphone other than a true omni-directional device*, (e.g. cardioid, figure-of-eight or even a dummy head) can also provide further detail and information on the local sound field and potential system performance.

5. COMPUTER-ASSISTED ANALYSIS

In part I of this paper [23], N. Abdulrahim and P. Doany describe A-CADX, a computer-assisted design package specifically developed for speech intelligibility predictive analysis with various methods being included for consideration of the user. In respect of the processing of measurement results, the methodology adopted is as described above for TEF/ALcons, TEF/STI and RASTI (B&K), with further allowance for modified S/N.

Some of these A-CADX features are summarised below:

(a) *TEF/ALcons*: extrapolation of %ALcons as a function of user-entry data relating to T, D/R and S/N. This is based upon the algorithm used by TEF [4], and offers the user the flexibility of checking these parameters against any defined criteria, not necessarily restricted to the 10% built into TEF. This process is linked with the predictive analysis module of the package, except for application of the correct algorithm, which differs from the traditional Peutz expression [2];

(b) *TEF/STI*: extrapolation of the STI values in any band of interest as a function of user-entry data relating to T, D/R and S/N [21]. The analysis, however is normally restricted to 500Hz-4kHz, unless the required data for a wider band analysis is entered by the user [23];

(c) *RASTI*: analysis of multirecords, including calculations of STI, S/N, effective-EDT, and rms error (ideal exponential decay), with plots of results [20-21]. Extrapolation of the STI values may also be performed as a function of user-entry data relating to T, D/R and S/N [21];

(d) *Modified-S/N*: the present A-CADX analysis module is based upon data recorded by TEF, with weighting function inclusions as an option. Results noted by the Authors thus far are not satisfactory, and further work is required here [20].

As to the quantification of parameters that affect T, D/R and S/N, the programme is also capable of presenting results of intelligibility expectations against the actual key parameters of interest, such as audience presence, ambient noise and so on.

6. SUMMARY

Suggested means of improving the accuracy of speech intelligibility objective measurements are briefly presented, including ALcons, STI, RASTI and modified-S/N. Limitations of these techniques are also outlined, further to areas of controversy associated with each.

It is considered that future developments are likely to improve the confidence limits of these techniques, especially in relation to application of the modified-S/N method.

Although these various methods are based upon intrinsically different physical parameters, it is interesting that the end intelligibility results provided do not differ significantly, if the indeed limitations of their application are respected.

A-CADX features in respect of the processing of measurement results are also briefly described, supplementing the first part of this paper.

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THE TRAINING INITIATIVE FOR PROFESSIONAL SOUND AND THE DEVELOPMENT OF NATIONAL VOCATIONAL QUALIFICATIONS FOR THE PROFESSIONAL SOUND PRACTITIONER

P.A.TURNER

SANDWELL COLLEGE OF FURTHER AND HIGHER EDUCATION.

THE TRAINING INITIATIVE FOR PROFESSIONAL SOUND

THE LEAD BODY FOR THE PROFESSIONAL SOUND PRACTITIONER.

T.I.P.S. was formed by the following representative bodies and learned institutes;

The Association of Professional Recording Studios (APRS)

The Audio Engineering Society, UK Section (AES)

The Sound and Communications Industries Federation (SCIF)

The Institute of Acoustics (IOA)

together with individuals who represent all Professional Sound Practitioners in every sector and sub-sector of the Media Industry along with Educationalists and Trainers.

T.I.P.S. has used the terminology "The Professional Sound Practitioner" as a generic term to describe those people who earn their living in the Professional Sound Sector which can be sub-divided into the following major areas of work as follows:-

1. Recording Studios
2. Record Preparation, Production and Distribution.
3. Radio Broadcasting.
4. Permanent Sound Reinforcement, Installation and Maitenance.
5. Temporary P.A. Equipment Installation and Operation.
6. Test Equipment and Equipment Design, Manufacture and Distribution,
7. Equipment Sales and Service.
8. Studio Design, Construction and Commissioning.
9. System Design and Commissioning.
10. Environmental Noise Specialists.
11. The Educators and Trainers
12. Motion Picture Production, Distribution and Exhibition
13. Television Pre-Production, Production and Post- Production Network
14. Theatre Sound.
15. Audio-Visual Media.

The Sector is estimated to offer job opportunities for professional employment of the Sound Practitioner, employing approximately 82,500 people.

The identification of occupational areas for the Professional Sound Practitioner is of prime importance to this study but, as an example of the types of employment available, we could illustrate the potential in music related activities.

For live performance there would be required:-

Musicians	Agents	Personal Management
Tour Management	Business Management	Front of House Engineers
P.A. Technicians	Monitor Engineers	P.A. Riggers
Road Crew	Lighting Engineers	Lighting Crew
Lighting Design	Equipment Technicians	Instrument Technicians
Merchandising Sales	Graphics and Design	Travel Agents
Drivers	Caterers	Wardrobe
Lawyers	Accountants	Venue Staff
Local Radio	Local Papers	Rehearsal Studios
Equipment Hire	Truck Hire	Computer Operators and Programmers

In record companies there would be:-

Acts and Repetoire	Marketing	Duplication Plants
Record Cutting	Record Pressing	Distribution
Master Production	Lawyers	Accountants
Graphics	Printing	Administration
Publishing	Computer Operators and Programmers	

Recording Studios would require:-

Studio Owners	Producers	Sound Engineers
Tape Operators	Technicians	Equipment Suppliers
Studio Engineers	Specialised Contrctors	Maintenance
Manufacturers	Acousticians	Computer Operators
Music Computer Programmers		

Video studios offer:-

Studio Owners	Management	Production
Direction	Cameramen	Continuity
Make Up	Hairdressing	Design
Sound and Vision Technicians	Sound and Vision Engineers	Script and Story
		Boardwriting

Suppliers to the Industry offer employment in:-

Retail Outlets	Manufacturers	Wholesalers
Distributors	Marketing and Sales	

There is an inter-relationship and cross-fertilisation of skills between all categories of employment for the Professional Sound Practitioner and, as can be seen, the Professional Sound Practioner is necessary to other Sectors such as Film, Television and Theatre. The skills of Management, Administration and Finance are necessary and common to all categories and, whilst these will be addressed by TIPS, it is recognised that other Lead Bodies will be addressing these issues TIPS though would wish to augment them where appropiate.

Employment for the Professional Sound Practitioner varies from permanent to short term contracts , to various freelance arrangements. The Sector contains a number of large employers of labour and also a considerable number of small companies in terms of their employment size. As an example a manufacturer may have a permanent work force of one hundred or more, but a promoter of a major musical tour may only employ ten people on a permanent basis but will be employing one hundred and fifty or more freelance and contract personnel during the length of the tour. A further example is the Broadcasting Station which employs fifty or more individuals on a permanent or contract basis, and the commercial Production Company supplying the Station which employs five.

In practice there are as many staffing structures, and within them working pratices, as there are companies within the Professional Sound Sector.

Despite there being Further and Higher Education courses aimed at the Sector together with privately run courses, manufacturers product training and familiarisation packages together with retail companies short training courses and seminars there is no coherent pattern of Education and Training for the Professional Sound Practitioner.

This lack of cohesive, structured, formal pattern of pre and post-entry Education and Training for all aspects of Professional Sound, from the technical and creative skills needed together with the organisational and management skills necessary, can lead to a situation where a market of quality staff in our dynamic Sector is not guaranteed, where the utilisation of new technology will not be achieved to the full, with there undoubtedly being many unidentified and unsatisfied Education and Training needs.

The situation also projects a bad image to the young and talented aspirant, who not only has difficulty discovering the organisations offering Education and Training but also cannot receive any real careers advice from either within the Sector or from the Careers Service.

Moreover it does not enable there to be any sensible, structured programmes of post-entry career development, an increasingly important aspect of Education and Training as the technology of our Sector becomes ever increasingly complex in shorter time spans. It is necessary to address the steep learning curves we all have to tackle with these advances in new technology and their application within our Industry.

Alternatively effective and efficient methods of Education and Training could enable there to be a stable recruitment pattern, an improvement of standards, better implementation of new technology, a more productive Professional Sound Sector and an improved public perception.

These problems became apparent through informal, succeeded by formal, dicussions between the four major representative organisations in the Professional Sound Sector, together with Educationalists and Trainers which led to the formation of the Training Initiative for Professional Sound (TIPS).

In June 1989 TIPS commenced a mapping study of the Professional Sound Sector. This study was jointly funded by the Training Agency, the Lead Body, and the Professional Sound Sector.

The study is based at Sandwell College of Further and Higher Education which acts on behalf of TIPS to deal with Administrative and Financial matters.

The study was undertaken by a project team consisting of:-

Project Director	Research Manager
Research Manager (Data)	Administration Manager

The study is monitored by the Executive Committee of TIPS comprising of 14 members; this committee met at the commencement of the study to set guidelines and will meet at the completion of the study to receive the following report.

A steering group consisting of seven members meets on a six weekly basis to monitor the study. The Project Director and the Research Managers submit progress reports to the Steering Group and will presenet the final report. The Training Agency is co-opted into the membership of both committees.

The aim of the study is to carry out a preliminary occupational manpower study with the following objectives:-

a) To identify the occupations to be covered by TIPS in pursuance of its role as a Lead Body and the development of work-placed assessable standards of competence, ultimately for national certification through National Vocational Qualifications.
b) To provide TIPS with the basic information required to undertake a systematic analysis of the occupational area and to allow the derivation of elements of competence and associated performance criteria.
c) To identify those Lead Bodies and Industry Training Organisations (statutory and non-statutory) whose work will influence the Professional Sound Sector and to develop cross-sector co-operation.
d) To identify other bodies not yet consulted.
e) To identify all Training courses in both public and private sectors aimed at the Professional Sound Practitioner.
f) To assess the level and quality of careers advice.
g) To develop a database.
h) To liaise with both the National Council for Vocational Qualifications and Scottish Vocational Education Council.

i) To liaise with National Awarding Bodies.

At the time of writing the study is half way through its six month period but is already able to present tangible, measurable outputs relating to the objectives.

We are able to:-

a) Identify the occupations to be covered by TIPS in pursuance of its role as a Lead Body. This provides TIPS with the information required to undertake systematic analysis of the occupational areas allowing deriviation of elements of competence and associated performance criteria and the development of work placed assessable standards ultimately for National Certification through National Vocational Qualifications
b) Identify those LB's and ITO's whose work will influence the Professional Sound Sector and the identification of other bodies to enable the development of cross sector co-operation.
c) Identify Education and Training Courses in both private and public sectors aimed at the Professional Sound Practitioner.
d) Assess the level and quality of careers advice.
e) Liaise with NCVQ and SCOTVEC. Both of these organisations have developed a close working relationship with TIPS which will facilitate organised, structured, flexible, efficient and effective National Vocational Qualifications for the Professional Sound Sector.
f) Liaise with National Awarding Bodies. TIPS has developed relationships with both City and Guilds and the Business and The Technician Education Council. These bodies at present validate some of the courses aimed at the Professional Sound Practitioner and discussion is on the way aimed at joint validation with TIPS.

THE DEVELOPMENT OF NATIONAL VOCATIONAL QUALIFICATIONS

The mapping study terminates at the end of November. At the end of October we aim to have comprehensive data to enable us to prepare the final report of this phase. The next phase will begin in December and will commence with functional analysis of the occupational areas.

During the mapping study we have also expanded the base of TIPS so that it becomes even more representative of the whole of the industry.

AIM OF THE STUDY

To enable the Training Initiative for Professional Sound in partnership with its Sector to establish work based assessable competences leading to National Accredited Vocational Qualifications.

OBJECTIVES OF THE STUDY AND METHODOLGY

1. Functional Analysis

- to define the key purpose(s) for those employed in the sector (as defined by the occupational mapping study)
- to identify further the functions and activities of those employed within each area - to complete this analysis for ten priority areas

2. Review of Functional Analysis

- to decide which qualifications currently assess the competences identified
- to propose a structure for new qualifications, where required
- to identify the order of priority in which the new qualifications will be developed and to assign two areas to each consultant

3. Deriving Competences and Performance Criteria

- to prepare full units of competence for the first ten priority areas

4. Design Assessments

- to prepare guidance on how each individual unit should be assessed

5. Field Trials of Assessments

- to run field trials of the assessments in suitable companies with individuals who would be prospective candidates of the qualifications

6. Design the Verification System(s)

- to establish the requirements of assessors
- to design the administrative systems to assure the ongoing quality of the qualification

7. Submission to NCVQ and SCOTVEC

- to enable joint development of national standards

8. Continuation of qualifications development work

- to continue to develop qualifications in the other occupational areas

To aid TIPS in this developmental stage it is proposed that we will utilise the skills of Moloney and Gealy, consultants in Assessment and Training, with Doctor Karen Moloney, the Principal, acting as our lead consultant together with another of the company's consultants. Throughout the project the consultants will work closely with the staff of the Lead Body.

It is proposed that functional analysis will take place for ten priority areas and that working parties will be established in these areas. These ten areas would have in them the majority of the skills of the Professional Sound Practitioner.

Each of these working parties will be co-ordinated by either one of two consultants, the Project Director or the two Research Managers, each having responsibility for two of the ten areas. Each working party will be led by one member of the Executive Committee representing one of the areas together with four representatives from the area.

The ten areas will be:

1. Recording Studios
2. Record Preparation, Production and Distribution.
3. Radio Broadcasting.
4. Permanent Sound Reinforcement, Installation and Maintenance.
5. Temporary P.A. Equipment, Installation and Operation.
6. Test Equipment and Equipment Design, Manufacture and Distribution.
7. Equipment Sales and Service.
8. Studio Design, Construction and Commissioning.
9. Environmental Noise Specialists in Industry.
10. System Design and Commissioning.

Functional Analysis of these ten areas will allow the derivation of a commonality of core skills and competences and the knowledge and understanding underpinning them for the Professional Sound Practitioner. It will further enable an effective and efficient method of building upon this core for specialist skills and copetences in the ten areas together with the five remaining areas;

11. The Educators and Trainers
12. Theatre Sound.
13. Audio-Visual Media.
14. Motion Picture Production, Distribution and Exhibition
15. Television Pre-Production, Production and Post Production Network and Station Operation

This developmental stage will be undertaken by the project team consisting of the Project Co-ordinator, two Research Officers and two Administrative Officers, together with the Consultants. It will be based at Sandwell College of Further and Higher Education. Sandwell College will make available office accommodation as a base for the project and will remit two-thirds of the Project Directors time to work exclusively for TIPS together with funding one of the Administrative Officers' posts.

The project will be monitored by the Executive Committee of the Training Initiative. This Executive Committee will be composed of the original members of the TIPS Executive Committee and will be joined by those previously mentioned. It will comprise at least 25 members representing amongst them all fifteen sub-sectors. This committee will meet on five occasions, at the commencement of the study to set guidelines, at the end to receive the final report and on three other occasions throughout the project.

A Steering Group consisting of 9 members will meet on eight occasions to monitor the project.

Ten working parties will also be initiated. Each of these working parties will be led by a member of the Executive Committee representing a sub-sector and will be co-ordinated by either of the two Consultants, the Project Co-ordinator or the two Research Officers.

Progress reports of these working parties will be submitted to both the Executive Committee, the Steering Group and the Training Agency.

PROJECTED TIMETABLE

PHASE	ACTIVITY	DATES
One	Executive Committee Orientation	December 1989
Two	Functional Analysis	January 1989 to May 1990
	Steering Group	January 1990
	Steering Group	March 1990
	Executive Committee	May 1990
Three	Steering Group Review of Functional Analysis	June 1990
Four	Deriving competences and performance criteria	July 1990 to November 1990
	Steering Group	July 1990
	Steering Group	September 1990
	Executive Committee	November 1990
Five	Design assessments	December 1991 to February 1991
	Executive Committee	January 1991
Six	Field trials	March 1991 to May 1991

	Steering Group	March	1991
Seven	Design the verification systems	June to July	1991 1991
	Steering Group	June	1991
Eight	Executive Committee	August	1991
	Submission to NCVQ		