CONTINUUM ENCYCLOPEDIA OF
POPULAR MUSIC
OF THE WORLD

VOLUME II:
PERFORMANCE AND PRODUCTION

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continuum
LONDON • NEW YORK
the material, without actual damage to the file. Such capabilities have been extended to computer-based multitrack recording programs, affording a level of flexibility that goes far beyond simple analog punch-in techniques. During the 1990s, computer-based recording and editing came into increasing use in a wide variety of popular music genres, but were especially useful in creating remixes in dance music.

Bibliography

PAUL THÉBERGE

Sound Engineering

Sound engineering provides a critical, mediating link between the performance of music and its reception by audiences. Sound engineers serve in several capacities, and they are typically responsible for evaluating the conditions under which music is to be performed and/or recorded and for overseeing the technical aspects of the performance or studio session. Both their technical expertise and their musical sensibilities are called upon as they select, position and operate sound reinforcement and/or recording equipment, and as they mix sound. In the case of recording sessions, sound engineers also prepare recordings for mastering and mass production, making alterations in the sound quality of the recordings that will often have an impact on their suitability for different media and their success in the marketplace. Traditionally, sound engineers are not involved in aesthetic and musical decision-making, as that role is generally undertaken by producers. However, it must be recognized that the decisions made by sound engineers, and the practises in which they are engaged, are inherently aesthetic in nature, and, in many instances, the roles of musician, producer and engineer overlap in subtle, yet significant, ways.

The tasks and responsibilities associated with sound engineering have changed radically over the past century. In some cases, these changes can be related to fundamental changes in the technology of sound recording, and in other cases to the changing economic organization of the record industry, the demands of musicians and the evolution of musical styles. In the early, acoustical days of recording, it was the task of the engineer to position the performers carefully in front of the recording horn in such a way as to achieve an acceptable musical balance, to prepare the mechanical devices associated with the recording turntables and to prepare the wax platters (shaving, polishing and heating them) for recording. The engineer’s primary responsibility was to capture the performance as well as possible, given the relatively crude tools available, and to ensure the technical quality of the recording — that is, make sure that the recorded grooves did not over-modulate or otherwise exceed acceptable limits.

With the introduction of electrical microphones and amplification in the 1920s, the role of the sound engineer changed in a subtle way. Now that it was no longer necessary for musicians to crowd around a recording horn to create sufficient sound levels for recording purposes, sound engineers (in many cases, drawn from the radio industry) were confronted with a new set of technical possibilities: selecting the right type of microphone and determining how many should be used (experiments with multiple microphones had already begun by the early 1930s), where they should be placed in relation to the ensemble and how they should be balanced were additional responsibilities for the engineer. Also, with the increased sensitivity of the microphone, new problems arose: for the first time, room acoustics (echo and reverberation) became a central concern in sound engineering. That these practices and concerns were more than technical in nature is evidenced by the debates around recording aesthetics that began to take place during this period and by the growing awareness that the sound of the recording itself (and not just the music) could be regarded as an object of aesthetic criticism.

It was during the 1950s, 1960s and 1970s, however, that sound engineering took on its modern form. During this period, magnetic tape recorders were first introduced into studio recording. The possibility of multiple recorded takes, tape editing, tape echo and other effects and, later, the development of multitrack recording practises all contributed to an increasing complexity in the techniques associated with sound engineering and an increased responsibility (both technical and musical) on the part of the recording engineer. Slowly, sound engineering began to be recognized as an ‘art’ in its own right and as a significant component in the achievement of a unique and marketable sound for popular recording artists. As entrepreneurial modes of production became dominant in emerging genres such as R&B and rock, an engineer’s willingness to experiment with the new techniques of sound recording was increasingly valued.

Mixing consoles and external effects devices also became increasingly complex in their design during this
period, and they began to have an impact not only in recording studio practice, but in live performance contexts as well. By the 1970s, major touring acts routinely employed sound engineers, and their task was no longer simply that of maintaining a band's amplifiers and public-address system. Rather, they had to position and balance a large array of microphones, process the signals with equalization, compression, reverberation and other special effects to achieve the kind of sound associated with the band's studio recordings, and compensate for club or stadium acoustics.

By the mid-1970s, the practises associated with studio engineering had become so complex that a certain degree of specialization had become inevitable. For example, in many professional studios recording assistants were employed to help in setting up the numerous microphones, cables and other devices that might be required on a session, to maintain and operate the tape recorders, or to keep detailed logs of the various recorded takes, their position on the multitrack tape, console settings and other aspects of the session. The performance of these seemingly menial tasks by recording assistants not only freed the recording engineer to concentrate on the more creative problems associated with recording, but also, in the essentially craft-oriented structure of studio work, provided many individuals with the experience necessary to become an engineer.

The chief recording engineer associated with a project would be responsible for the following: conferring with the artist and producer prior to a recording session in order to gain an understanding of the musical and aesthetic requirements of the recording; supervising the overall session and any assistants participating in it; operating the recording console; setting balances and tonal quality; ensuring the technical quality of the basic recorded tracks; and (together with the producer) ensuring good performances. Once recorded, the tracks require a different set of engineering considerations, and often different engineers would be employed at this stage of the process.

Engineering a mix (which is not unlike sound engineering in live performance contexts) requires the ability to take a large number of instrumental and vocal inputs and put them into a musically and tonally balanced form, a detailed technical knowledge of a vast array of signal processing equipment, and a sensitivity to the aesthetic character and requirements of the music at hand in order that the desired artistic result may be achieved. Once the mix engineer, artist and producer are happy with a recording, it must be subjected to one last set of engineering requirements during the mastering stage: the adjustment of overall recording levels and additional equalization, for example, to optimize the recording for particular recording formats or media. Here again, specialized mastering technologies and specialized engineers are usually employed.

Modern sound engineering has thus become a multi-stage process involving a number of discrete tasks. As recording technology has developed and become more specialized, sound engineers are sought after both for their understanding of the overall recording process and for their knowledge of the state-of-the-art developments in new technology. Sound engineering thus plays a critical role in the recording process, acting as a link between technology, the musicians, sound and music.

Certainly, by the 1980s and 1990s, many popular musicians had recognized the importance of sound engineering in the recording process and had developed close relationships and artistic collaborations with sound engineers. Often, as in the case of rap music, they broke with conventional engineering standards and recording aesthetics, and pushed the technical capabilities of recording devices beyond normal expectations in search of a unique sound. Others took it upon themselves to learn the basic principles of recording, signal processing and mixing, and built expensive recording facilities of their own. But, while the acquisition of such knowledge has become an essential part of every musician's experience, the increasing complexity of sound recording and reinforcement technology (the development of MIDI technology and computer-controlled audio, for instance) and the new demands placed on engineers by the industry (such as those of creating special mixes for dance club use and synchronizing music to videoclips) have ensured the professional sound engineer's central role in musical practises.

A testimony to the increasing complexity and specialization within the art of sound engineering can be found in the emergence, in the latter part of the twentieth century, of sound engineering programs in universities, technical colleges and private institutions. While on-the-job experience has continued to be a major prerequisite for a career as a sound engineer, it is clear that the range of technical knowledge and skill required in modern sound engineering is much greater than can be absorbed through informal apprenticeship in the studio. Sound engineering has become a diverse, technical and artistic practise that requires years of both formal and informal training and a constant renewal of knowledge and skills in relation to the changing contexts of technological development, industry structure and musical style.

Bibliography
Synchronization

Synchronization is a process in which the transport mechanisms of two or more audio, video or other devices are made to operate at exactly the same speed. Synchronization also allows the devices to find precise locations in the recorded material and is essential, for example, in adding dialog, sound effects and music to video or film images. In purely audio applications, synchronization has often been used in professional sound studios since the 1970s to lock together two multitrack tape recorders in order to increase the number of available tracks. For example, two 24-track recorders can be synchronized together, effectively doubling the number of recording tracks. In actual practise, however, one track on each machine must be dedicated to recording synchronization data, so a maximum of 46 tracks are available for recording music. It is also common for engineers to leave at least one blank track adjacent to the synchronization tracks so that any possible leakage between tracks does not interfere with the recorded music. This further reduces the number of actual tracks available for recording. In some digital audio applications, a clock signal, operating at the speed of the digital sampling rate (e.g., 44,100 or 48,000 times per second), can be used to ensure that digital tape recorders, computers and other devices maintain synchronization accuracy down to the level of the individual sample, and it does so without using up recording tracks.

The most common synchronization standard used in professional recording studios is known as 'SMPTE time code,' a digital protocol developed by the Society of Motion Picture and Television Engineers (SMPTE). It consists of digital data that designate time in the form of hours, minutes, seconds and frames. It is used extensively in film and video postproduction, but also in synchronizing audio tape recorders to one another and to computers. However, with the increasing use of electronic instruments (synthesizers, drum machines and sequencers) and computers in recording studios during the 1980s, a number of other protocols have also been employed.

A relatively simple method of synchronization was developed for early drum machines and sequencers: it consists of a clock pulse operating at a precise subdivision of the beat (referred to as 'pulses per quarter note' or 'ppq'); thus, while the clock rate is fixed (usually at 24, 48 or 96 ppq), the actual speed of the clock pulse is tempo-dependent. The clock of one device can be used to drive another, provided that they both operate at the same clock rate (which was often not the case, especially when an attempt was made to synchronize equipment from different manufacturers). Some drum machines and sequencers can also supply an audio signal, operating at the clock rate, which alternates between two pitches (a technique known as frequency shift keying or FSK); the signal can be recorded and used to synchronize the device with multitrack tape recorders.

Because the internal clock rate of electronic instruments can vary so widely, synchronization was often a hit-or-miss affair until the introduction of the MIDI (musical instrument digital interface) specification in 1983. The MIDI specification includes its own timing data, corresponding to a standard reference of 24 ppq, and data for finding specific locations within a song ('song position pointer'). To bridge the gap between the SMPTE standard and MIDI, yet another protocol - MIDI time code (MTC) - was introduced in 1987: MTC converts SMPTE into MIDI messages and allows the tempo of sequenced music to operate independently while maintaining 'real time' synchronization with external devices.

Bibliography


Synchronization

'Synchronization,' in terms of the cinema, refers to the process of perfectly coordinating sound with an image for the exhibition of a motion picture. The practise of synchronization is as old as cinema itself: the test film that inventor William Kennedy-Laurie Dickson made for Edison in 1894–95 shows Dickson playing his violin into a sound-recording device as two assistants dance for the camera. Although sound film processes were available at the very beginning of the twentieth century, and were introduced again about a decade later, problems with amplification and synchronization, which depended on