Music in the Social and Behavioral Sciences: An Encyclopedia

Sound Engineering

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Sound engineering refers to the design and implementation of hardware and software to create, manipulate, and transmit sound. In the 21st century, electronically produced sounds have penetrated nearly every facet of life. This is most apparent in connection with music. There are also many artifacts of the urban environment that are enhanced by sound, such as traffic lights, mobile phones, and lifts. Sound production is not only electronically created but also using biochemical and mechanical processing. In this respect, sound engineering is more than just work that takes place in a recording studio or at the computer, even though these two contexts account for the majority of sound production. Sound-related work in laboratories or on test products may also be considered sound engineering in a broad sense. Engineers and product designers may be engaged in optimizing work in sound design, acoustic engineering, audio branding on optimizing the sounds of cars, houses, or foodstuffs. Their goal is to make the latter quieter or louder or to design them such that they produce a recognizably typical or ideal sound—usually one that is as familiar as possible.

The term *sound engineering* also relates to the (re)production of music, language, and ambient recordings, or to the controlled transmission or broadcasting of acoustic information (e.g., radio interviews, music streaming on the Internet, or open-air concerts). Different audio (and visual) sources are combined and transformed into sound-intensive artistic formats (such as films, radio plays, and video games). The manufacturing of the appropriate audio systems (such as transmission, conversion, recording, measuring, process, and playback equipment) is a prerequisite and a part of sound engineering.

Historical Developments

The conscious manipulation of sounds can be traced back to the beginning of the mechanical building of instruments—to prehistoric times. However, it is only since the late 19th century that electro-acoustic transmission and variation have been possible (such as via telephone and telharmonium).

In the first half of the 20th century, a rapid process of progression began in this field, which was closely connected with the burgeoning development of industrial music and

film technology (including record players, the radio, and sound films). Physicists (e.g., Leon Theremin), engineers (e.g., Friedrich Trautwein), business-minded inventors (e.g., Emil Berliner and Thomas Alva Edison), composers (e.g., Oskar Sala), and **[p. 1047 ↓]** instrument makers (e.g., Les Paul) pushed forward the development of sound engineering.

In the second half of the 20th century, electronically operated sound media turned into mass-produced items (such as musical instruments, hi-fi systems, car radios, the walkman, and televisions); they become affordable and from that point onward a part of daily life. A worldwide process of technical and aesthetic differentiation of such sound media occurs, and new products are constantly appearing on the international market.

There are two markets, one for specialists and one for laypersons. While the still relatively high-priced products increase in complexity for the specialists and presuppose expertise on the part of users, the products for ordinary customers are characterized by intuitively operated user interfaces and a good price-performance relationship (e.g., electric and electronic musical instruments and playback devices). Sound production that sets the standard still remains in the hands of the experts. New career paths open up, which standardize and institutionalize sound engineering (e.g., audio engineer, sound technician, and recordist).

At the end of the 1970s, digitalization establishes itself in the music business, which then follows a trailblazing path in the 1980s (with the synthesizer, sampling, and compact discs). At the same time, music technology merges with computer technology, which has the effect of introducing a new field of specialization: music informatics. The sphere of operation of professional sound producers is thus significantly extended. In addition, it is now also possible for semiprofessional musicians, filmmakers, radio artists, and sound artists to put together—with manageable technical and financial means—quality productions.

In the 1990s, the personal computer found its way into private households, followed by the laptop in the 2000s. Since then, it has been possible for practically anyone, with the aid of reasonably priced audio software and/or simple interfaces (digital-analog converters), to produce technically (and artistically) demanding works, without requiring a more thorough understanding of the electro-acoustic processes in the background.

Subdomains, Fields of Application, and Career Paths

Acoustics is an interdisciplinary field, which can be described as the science of sound and hearing. It forms the theoretical basis for sound engineering. Architectural acoustics is a subcategory of acoustics, which concerns itself with the planning and improvement of the acoustic properties of built spaces. Architectural acousticians who have highly sensitive measuring instruments at their disposal are especially required in the construction of recording studios, large concert halls, and opera houses, but also in the installation of permanent sound reproduction systems in open spaces.

Hearing physiology is a further subcategory of acoustics, and is consequently of importance for professional sound engineering. The primary concern here is how human hearing works and what sound parameters humans are sensitive to. It is important for the design of loudspeaker systems, headphones, or hearing aids. Hearing aid acoustics has developed in recent years into an independent specialism, which offers the hearing impaired support through increasingly precise technical devices. Hearing aid acousticians can accordingly be designated as medical sound engineers, who apply their knowledge directly at the ear.

Psycho-acousticians are equally interested in the ability to hear, but approach the phenomenon primarily from a psychological or neurobiological perspective. Psychoacoustic work, for example, is incorporated in the development of digital compression formats (such as MP3, Ogg Vorbis, and WMA), which are necessary to economize to the maximum on the space needed to store audio data.

Psycho-acousticians are in turn dependent on computer scientists who are familiar with sound-related programming. Usually, these are specialists in music informatics who create audio software. To a certain extent, they are the electro-acousticians of the 21st century, even though they have little to do with hardware, that is, real equipment. Their world of work is predominantly virtual.

Electro-acousticians, on the other hand, are involved in the production of nearly all electronic components and equipment that is used for sound engineering (such as microphones, mixers, and amplifiers). They possess the hard technical **[p. 1048 ↓]** knowhow, and place their innovative engineering arts at the service of the artistic sound producers.

Artistic Sound Production

All those who are involved in acoustic art in its widest sense are counted as artistic sound producers or designers. Their technical skills are, as a rule, subordinated to their artistic abilities (except for audio engineers). The majority use commercially available technology, using it in a more or less intuitive fashion. They often seek unconventional ways of utilizing the products, which were not intended by the manufacturers (such as scratching on record players, mistuning electric guitars, and coupling different computer programs).

Originally, composers of electro-acoustic art music (e.g., Pierre Schaefer, Karlheinz Stockhausen, and Edgar Varèse) discovered the potential of the technical sound media for their avant-garde experiments. After World War II, they saw electric equipment as a way out from the traditional sound of orchestral instruments. Since the 1960s, musicians who play popular music have made excessive use of electronic sound manipulation (e.g., The Beatles, The Beach Boys, and Pink Floyd). In a parallel development, the film industry has increasingly focused on electronically produced sounds, in most cases when the impression of a futuristic or mysterious atmosphere is created, and combines these with music, ambient noise, and spoken passages. In this way, compacted sound entities are created, which require serious effort to be harmonized with each other. The same is true for radio and television, which make maximum use of all the available technical and artistic sound options. On the border between musical composition, radio play, and sculpture, acoustic art is under development, which creates sound installations.

Since the 1960s, a successive amalgamation and fusion of audio and visual techniques has been observable, which culminated in the contemporary term of audiovisual media. Other terms such as virtual media or digital media are often used as synonyms. For

sound engineering, this means that it is gradually subsumed in a creative technology, which presupposes an audiovisual workflow (such as the Pure Data visual programming language or Adobe Creative Cloud). The segregated training sectors and courses that address sound engineering will in the future transform themselves into one multidimensional teaching approach, which will be ready with audiovisual content from the outset. This can be seen in current higher education tendencies that are reflected in terms such as media informatics, media technology, and electronic media studies.

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See Also:

- Computer Models of Music
- Computer Music
- Dynamics
- Electronic Music
- Manipulation
- Recording
- Recording Industry
- Sound
- Soundscape
- Technology

Further Readings

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