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**Technology and Creativity
in Electronic Music Composition**

Kıvılcım Yıldız Şenürkmez, PhD, Turkey

In the first half of the 20th century, the enhancement of recording techniques, the development of music technology and musical acoustics opened up new horizons in the exploration of musical/sound material. With the early stage developments of the music technology, composers were introduced a new variety of expressional opportunities in the creation process. Not only the new production/creation process has emerged, but also transmitting, storage and the reproduction of sound material have greatly increased the possibilities of the music dissemination. Therefore, music technologies created a noticeable expansion of common shared experience which had a huge cultural impact. Today, the present electronic and digital technologies introduce new technological elements and create many changes in the concept of musical material (especially the concept of timbre) and musical structure (formal schema), as well as in the temporal fields of composition. In these circumstances, the aim of this paper is to focus on various aspects, in relation to the aesthetic directions, pertaining to electronic and electro-acoustic music, such as the relation between techniques and technological creation with the impact of technology on music, discussion on certain aesthetic issues of creativity/compositional thinking in electronic music, analyzing the changing aspects of traditional aesthetic definitions of musical experience (transformation in musical performance), examining the aesthetic issues concerning musical time, and the new ways to explore the temporal limits of electronic music.

Technology and Art

The relationship between art, technique and technology suggests the tension - differentiation between the artwork which is created with aesthetical concerns and the production mechanism. Artistic production is understood as the opposite of mass production. Technical knowledge is the prerequisite for any artwork. With the emergence of the new technologies, the transition from techniques to technologies created new possibilities for arts as well, though among all types of art, the “meaning” of the alternation - transition process of music, emerging with the technology, has not been thoroughly analyzed.

For many critics, the notion of technique does not have an internal logic of development or does not have a fundamental capacity to change its own perceptive field. In this context, the concept of self-determination of technique is rejected. But on the other hand, the intense influence of technique on any art form cannot be denied. Every new technique overrides the existing ones and offers a new formal process which enables the artists to

explore, utilize and exhaust alternative series of possibilities. The transition from techniques to technologies develops a permutation and pluralism within the arts.

The negative side of technology appears in relation to its reflective nature of the society and its members. At this point, it is possible to discuss the negative side of the technology, regarding all of the parameters of the society. On one hand, technology implies independence from social and other forces. It leads into tools that are basically separated from the context of their use. But on the other hand, it appears as a kind of control mechanism and dominates all the aspects of our lives. Apart from this negative view, the issue of technology arises "from its social and political application, rather than as an inherent quality of technology itself".¹

One of the distinctive features of technological evolution and its aftereffects was replacing craftsmanship with mechanization. Especially, the present electronic age has introduced noticeable new elements of technique. In our post-industrial world, newly created electronic and digital devices, machines and etc. characterize our productive imperatives. The use of these new technologies enables us to discover previously unexplored areas. At this point, it is possible to note that art and technology establish a structure which significantly triggers each other and extends as paralleled.

...art-making poses a unique set of epistemological and, as such, technical problems, since it is not just concerned with solving problems, but with generating and forming them. It values itself in the kind of *revealing* that Heidegger described as constituting the essence of technology ...Heidegger finds a direct link between technological practice (techne) and art-making (poiesis) in that both are a form of; for him, techne and poiesis constitute highly overlapping domains of activity.²

In music, a variety of new means for creation and dissemination of music became available with the expansion in audio technology. In other words, the strong alteration in technology gave rise to a completely new process in the field of composition, just as in the other non-art fields. Sounds have started to be produced, recorded and reproduced technologically. Since the composer or performer works in an electronic medium during the creation process, he/she may think that he/she is losing his subjectivity as a composer. Dramatic technical developments changed artistic approaches; and more generally the essence of the arts and music are also deeply altered. Electronic and digital sounds that are produced in the recent years emerge as themselves, as well as objects out of themselves.

Historical Concerns

In order to understand the effects of the technological development in the musical creativity, it is necessary to mention some of the key points in the historical evolution. In music, technical breakthroughs are developed from acoustic to electronic; monophonic to stereophonic; analog to digital, etc. In the creation of tools and technologies, we come across with two practices which are connected to each other. Initially, the equipments for recording and reproduction of music have been developed. On the other hand, new tools for compositional creation have also emerged. However, at the beginning, electronic music has used equipments which were not specifically designed for compositional applications. Starting with recording, the technological evolution has gradually proceeded to the highest level of production. In the 40's and 50's, many developments have taken place simultaneously. The recording technology has expanded with magnetic tape and long-playing record³.

With the progression of magnetic tape recorder⁴, electro-acoustic music was of interest to many composers. These composers became interested in electronic music as a source of new sounds. In these years, with "electro-acoustic music"⁵ not only the creating process was affected, but also the role of the live performance and the meaning of notation were brought in question. The manipulation of sound material (sonic material) became accessible with magnetic tape and other types of different electronic devices. In the work process, it enabled the composers to work directly in their environments, without any requirement of assistance by the performers. These equipments allowed the composers to create directly, without having to submit their work for interpretation through a different medium by a performer. However, this situation in pure electronic music was different when it came to electro-acoustic music. The performer was assigned important tasks, in the development of the work framework.

In relation to electro-acoustic music, various kinds of sonic processes became available for composers, such as alteration of sound characteristics, controlling of sound intensity, manipulating the nature of the sound and etc. These improvements have emerged in various ways. All of these were related to the capabilities of the electronic tools. Many composers, each through his/her own preoccupations, worked together in many research centers, especially in studios. Pioneers of *musique concrète* were a few French composers (Pierre Henry and Pierre Schaefer were the most important ones of all). They were working at Paris studios and collecting acoustical sounds and manipulating them electronically. The pioneers of *elektronische Musik* were a few Germans (Herbert Eimert and Karlheinz Stockhausen were the most important ones of all). They were working at Cologne studios with the sound material itself which was electronically generated. These two approaches to electronic music were based on impulses, sine waves, noise generators and oscillators.

In the 50's, there were many electronic music centers.⁶ In these centers, the composing activity was a repetitive, frustrating task, involving splicing tape manually, recording and rerecording sound on magnetic tape. A great step in reducing the work time was the development of an electronic synthesizer which was created by the Radio Corporation of America.⁷ This synthesizer became the keystone of Columbia-Princeton Electronic Music Center (Otto Luening, Viladimir Ussachevsky and Bülent Arel were working at this Center). Thus this synthesizer made it possible to practice, not only by controlling sound components, but also by controlling timbre, dynamics and rhythm.

During the 60's, technologists developed less expensive, smaller synthesizers with easier operational process.⁸ It is not easy to find out whether these modular synthesizers were developed for the needs of the composers or not. Nevertheless, it is clear that electronic music has entered into the new stage of today's practice with these new developments. The extensive usage of the electronic instruments for composing music and the recording tools that were continuing to develop has been altered with the employment of the digital techniques, and especially digital computers have assisted the composers, both at the recording and the composing of music. It was another important advancement in reducing the work time.

Digital Age

In the 70's and 80's, the electronic music tended to branch in various directions. Working with computers, the pure forms of electronic music in many works dissolved in a kind of "noise aesthetic". During those years, high-quality equipments were used in music for

recording. Consequently, technology in a broader sense replaced the live performance events. Moreover, due to the high quality that is achieved by the recording technology – CD, DVD, mp3 etc. – the diffusion of the good quality recordings has turned out to be a threat for live events.

With the help of the electronic devices, all electronic music tools can be classified in three groups: electro-acoustical, electronic-mechanical and purely electronic instruments. Electro-acoustical instruments are used to imitate the sound of conventional instruments. Electronic-mechanical tools have been designed to provide an individual sound, to use in conjunction with conventional instruments. The last category, electronic instruments are purely electronically performing instruments. In these categories, various kinds of electronic instruments that are used in the composition process had an important impact on the creative process, such as the choice of the composition process, materials and the quality of the sound produced. Instead of listing all of these developments, the aim is to focus on determining the key factors in the development of the electronic music.

Both the materials to be composed and the process of composition have gone through a phase of a radical change. A significant level of proficiency or technical equipment is now necessary, in order to comprehend the operations that are performed through the new developments in the digital applications. In this case, the composer should have (technical) knowledge, in addition to the composition techniques. The composers need technicians to assist them in some cases. In this case, one can question the subjectivity of the musical projects that have been created together. Nowadays, the majority of those who are occupied in electronic music, aim at attaining a level of knowledge, almost the same of that of a sound engineer, with an extra package of information, which is regarded as an important factor in composing.

On the other hand, another important medium is the studio environment, in relation to the creative process of electronic music. With their changing nature, studios represent the more complex working environment of composers. The studio environment, each of them different from one another in the creation of electronic music and which is going through a rapid change, is not the main point of interest, but still has a specific importance. The composer selects and creates the creative aspects of electronic music, but there are imposed aspects, as a result of the physical environment of the studio. These imposed aspects remain the same for all users in this environment. The studio environment is similar to the case of music that is created merely by a computer. In this regard, computer programming (referring to the wider sense of the term) represents the similar characteristics with the studio environment.⁹

Recent digital developments on computer allow all types of modification in each parameter of the music. Programming also makes it possible both programming of timber itself and the formal schema of music. As an important composer, Iannis Xenakis extended his compositional technique to the field of sound and stressed the interpretive appropriation of technology. He also invented languages for music programming. He asserted that:

The effort to reduce certain sound sensations, to understand their logical causes, to dominate them, and then to use them in wanted constructions; the effort to materialize movements of thought through sounds, then to test them in compositions; the effort to understand better the pieces of the past...which should be identical with that of the scientific thought of our time...¹⁰

In the extreme case, it is even possible to produce the software for aleatoric procedures. Although aleatory cannot be imagined for a computerized procedure, this opportunity is employed too, with various methods. This programming experience, attained with the existence of multi possibilities emphasizes in a sense, the subjective and objective dimensions of technology. Some of the developed programs aim at simplifying the common composition methods.

In addition to these, the primary stage of composition, including the construction and the selection of sound material in the creation process became much more important, in the light of those developments. In contrast to the conventional, top-down planning where the composer brings his design into life, the pre-compositional stage is of great importance in the creation of electronic music.

As a consequence of the preoccupation of composers with electronic tools or work in the studio environment, the fact of "sound" is considered in a wide perspective, extending from production to perception. Computer and other electronic and digital tools became irreplaceable working tools - from printing out scores to playing back, creating synthesized sounds or imitating orchestral sounds and etc.- not only for electronic music composers, but also for the composers, who are occupied with live instruments or conventional ways of composing, and they were affected with these changes too.

Conception of Time

By the 50's, electronic equipments made it possible to reach to the previously unapproachable limits of composition:

The analog signal generators of the 1950's let composers create for the first time sequences of impulses that could be transposed to different time scales by means of tape speed manipulations.¹¹

It was only with the beginning of digital audio techniques that a micro approach to sound could be considered in depth. Thus, expanding the limits of musical material and the field of composition to a broader range of acoustic phenomena, many different concepts came into use, such as molecular properties of sonic material, micro-sound and micro-structure. In relation to the perception of micro-sound, the temporal field also expanded with the awareness of the micro-time scale. As a new area of the phenomenological perception of musical time, the possibility of working on micro-time scale could be practicable to high-level musical structure. In relation to this, Xenakis articulated his ideas as follows:

Suppose that each point of these [granular] clusters represents not only a pure frequency... but an already present structure of elementary grains, ordered a priori. We believe that in this way a sonority of a second, third, or higher order can be produced.¹²

Today, the temporal dimension is controlled largely by computers. In this way, it can be stated that a musical idea is not shaped according to the principles of functional tonality or any other related configured system, but is fundamentally one individual sound or blocks of sounds, shaping time, rather than being shaped by it. Thus the whole perception of time is altered and reduced by the individuality of the sound objects.

Concluding Remarks

Here in this short presentation, the opportunities for the creativity of the composers, emerging through the technological developments and their respective effects have been in focus, rather than technical details. Parallel to these technical developments, the musical approaches of the 20th century continued their progression as new ideas. Electronic music too has continued to progress by attaching itself to those new concepts, but has resulted in significant changes in the perception of music and through the different expression possibilities that were introduced. Composers started to think about sound materials and their individual processes more deeply and asked themselves the fundamental question of what music is. In relation to this, Herbert Eimert explained the transformation process of the sound material and the new ways of compositional thinking:

The work of composition begins first with the mastering of the "material", in other words, the given material itself must suggest a suitable and direct method of erecting and working on it. The composer... is no longer operating within a strictly ordained tonal system, finds himself confronting a completely new situation. He sees himself commanding a realm of sound in which the musical material appears for the first time as a malleable continuum of every known and unknown, every conceivable and possible sound. This demands a way of thinking in new dimensions, a kind of mental adjustment to the thinking proper to the materials of electronic music.¹³

Although the focus here is aimed to be the employment of the technological developments in music in the creation stage, the contribution of technology by simplifying work and saving time is also an important stage.

In these circumstances, various issues in relation to creativity and technological improvements in music can be summarized as follows:

- Technology can be regarded independently from social and other forces. It emerges via different tools, in order to satisfy various needs, but on the other hand, the aim of using these tools is a separate subject. It delivers itself into tools that are essentially separated from the context of their use.
- In general, the essence of the arts and music has dramatically changed with the technical developments, as well as the artistic approaches. The expansion of the audio technology has enabled a variety of new means for the creation and dissemination of music.
- In music, new technologies enabled us to discover new areas of sound that previously were not even imagined. Various kinds of sonic processes have become available to composers.
- Not only the creation process was affected, but the role of the performer and the meaning of notation were also put into questioning.
- The primary stage of composing process, including the selection and construction of sound material has become much more important, due to those developments.
- Starting with the digital audio techniques, molecular properties of sonic material and the micro-time scale were made practicable in musical structure.

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¹ HAMMAN, M., "On Technology and Art: Xenakis at Work", *Journal of New Music Research*, p.3

² HAMMAN, M., "On Technology and Art: Xenakis at Work", *Journal of New Music Research*, p.12

³ In the very early stage, composer Edgar Varèse (20's) regarded the idea of "organized sound" as a new path in the history of music.

⁴ John Cage was the first American composer to prepare a piece on a magnetic tape; *Imaginary Landscape* No.5, 1951-52

⁵ Electro-acoustic music is generally regarded as a body of art-music genres that evolved from compositional techniques and aesthetic approaches developed in the 1950s. During this decade the growing availability of magnetic tape offered composers a high-quality recording medium which allowed greater experimentation in the manipulation of recorded sounds. (Grove's Dictionary Music and Musicians) Preliminary electro-acoustic works are O. Luening's *Space, Low Speed and Invention*, 1952; O. Messiaen's *Timbres durès*, 1952; E. Varèse's *Déserts*, 1955, *Poème électronique*, 1957-58; K. Stockhausen's *Kontakte*, 1959-60 etc.

⁶ The most important early classical tape studios are *Club d'Essai, Radiodiffusion-Télévision Français*, Paris (1948); *Tape Music Studio*, Columbia University, New York (1951) [now *Columbia-Princeton Electronic Music Center*]; *Studio für Elektronische Musik*, Westdeutscher Rundfunk, Cologne (1951); *Electronic Music Studio*, NHK (Japanese Radio), Tokyo (1953); *Studio di Fonologia, Radio Audizioni Italiane*, Milan.

⁷ It was called Mark II and was installed in the Columbia Studio in 1959

⁸ Voltage-control analog synthesizers had become available, manufactured by Moog, Arp, Buchla and other small companies. Analog synthesizers offered control through low-frequency oscillators manual keyboards and analog sequencers. (ROAD, C., *Microsound*, p. 329)

⁹ Computer-assisted automated systems, some more suitable for spatializing live electronic music than for diffusing works in fixed recorded format, appeared developed at IRCAM in the 1980s, used for Boulez's *Rèpons*. (Grove's Dictionary Music and Musicians)

¹⁰ HAMMAN, M., "On Technology and Art: Xenakis at Work", *Journal of New Music Research*, p.8-9

¹¹ ROAD, C., *Microsound*, p. 329

¹² ROAD, C., *Microsound*, p. 331

¹³ WÖRNER, K. H., *Stockhausen: Life and Work*, pp. 122-123

Kıvılcım Yıldız ŞENÜRKMEZ

e-mail: kivily@hotmail.com

Address: Otağtepe Caddesi,

Timuçin Sokak, No:1 Daire:6

Kavacık-ISTANBUL

Tel: 0216 4657679

0542 2311646