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**MAN – MUSIC – TECHNOLOGY: The question of the influence of technology on the musical thinking of the 20th and early 21st century**

Abstract/Commentary on the habilitation thesis

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**1. Subject, Scope and Methodology of Research**

The basic question posed by this work is: how did the evolution of technology, its relationship to music and the development of human attitudes to technology in the process of musical production transform musical thinking in the area of the artificial composed music of the 20th and early 21st century.

The central notion of this thesis is musical thinking, which profiles not only Brno musicological school founded by Vladimír Helfert, but also Czech musicology in general starting with Otakar Zich. Helfert founded an objective method for gaining knowledge of a musical work based on the analysis of two basic elements: the source of inspiration and the musical structure.

The central point of interest in this treatise is the transformation of musical thinking in the conditions of new technologies and resulting aesthetic movements. The relationship between man (society), music and technology that has developed in the Euro-American cultural and historical context can be expressed using the triadic model.

Technique or technology are further prerequisites for the existence of music (compositional technique, technique of singing, instrumental playing technique, instrument design technology, reproduction technology, etc.). In fact, we could consider the problem of technology as part of the issue of music itself. However, artificially separating technology from the field of music will allow us to analyse this problem in a wider context (social, historical and aesthetic).

The relationships being examined in this thesis based on the above triadic model are: 1. The development of technology (instruments) in relation to artificial music, 2. The transformation of music (as an artefact or process) under the influence of new technologies, and 3. Musical thinking in the artificial music of the 20th and the beginning of the 21st century as a result of changes in technology.

These three elements form the basis of the music communication scheme, which is our adaptation of Shannon and Weaver's linear transmission communication model:<sup>1</sup>

**AUTHOR – ACTION/SCORE/RECORDING – WORK – [INTERPRETATION/REALISATION] –  
RECIPIENT**

This is a model of the one-way flow of music information from the author to the recipient (or even further to reflections and metareflections of music). For the purposes of our discussion, we will use the first half of the scheme; that is, between the author and the work, i.e., around the pole of music production. To explain part of the "action/score/recording" scheme: these are means of creating a musical work. This is created either by a live action (improvisation), by a fixation of the thought structure in musical notation or by the creation of a work directly in the sound material (e.g., *musique concrete* or electroacoustic music).

This thesis does not deal with the transformation of the reception and consumption of music through technology (i.e., the issue of reception habits, environment, music distribution, etc.), as this area of research presupposes a completely different methodology.

After introductory definitions, contextualisation, theoretical and specifically oriented aesthetic chapters, this work offers a series of case studies of individual creative poetics that show the changing relationships of creators (musicians and composers) to technology during the 20th and 21st centuries.

We believe that the goal of musicology as a humanistic art discipline should not only be to ask instrumental questions of the "how?" type (such as in music theory), but especially those of the ontological "why?" type. This condition also applies to the relationship between music and technology. It is obvious that the issues of this relationship have so far been limited almost exclusively to those of "how?" instead of "why?" and the exploration of context. We lack knowledge of the causes and the interpretation of why 20th century music, which is clearly the domain of technology - both analogue and digital - exists exactly as we know it. Technology is not merely one of many factors in music, but it is the key to understanding 20th century music. The literature so far has dealt with the relationship of technology and music relatively unilaterally from the perspective of the technology used to (re)produce music, and not from that of the music structure, which is being transformed by this technology.

Given the historical nature of the studied problem of the relationship between music, technology and man, which extends across the 20th and early 21st centuries, it is also necessary to take into account theories that are now widely regarded as obsolete, such as technological determinism. As part of this critical reflection on technology, the relationship between music and technology in the context of musical thinking can be defined more

specifically. The coexistence of the modalities of both areas can be expressed by moving on the axis depending on the intensity of the interaction from stronger positive (techno-utopianism) to weaker positive (techno-optimism), realistic (technorealism), to a strongly negative or critical relationship (techno-scepticism or post-technology).

## **2. Definitions of Basic Terms**

Since technology is a transversal concept that goes through all sorts of spheres of human thought and action, it is necessary to look at it in its contextual definition at least in the most related sciences, such as aesthetics and sociology. In the thesis we critically discuss commonly available academic encyclopaedia entries (The Encyclopaedia of Aesthetics<sup>ii</sup>, Great Sociological Dictionary<sup>iii</sup>, Dictionary of Czech Musical Culture).

The notions of technique and technology overlap in the Czech language. (Therefore they will be used partly synonymously in the Czech version of this habilitation thesis.) We further consider technology to be a set of applications of research results of natural and technical sciences. Thus the problem of the relationship between technology and music is that of the relationship between music and the natural sciences.

## **3. Discursive Framework, Current State of Research**

The basic discursive framework of this thesis is systematic musicology, especially musical aesthetics as a specialised philosophy of art, and further music theory and sociology. The musical-historiographical aspect is represented by a projection of the issue on a chronological axis.

Hierarchically the highest disciplines in which the chosen approaches intersect are philosophy and musicology. The tradition of philosophical thinking provides us with the conditions for the intellectual reflection of technology, which concerns the essence of this issue in relation to man and society, or, for example, the ontological status of technological work, while musicology offers an analytical, interpretative and pragmatic framework of interpretation. From the point of view of the philosophy of technology, for the purposes of this work, two main points can be mentioned: *The Question Concerning Technology (Die Frage nach Technik)* by Martin Heidegger and *The Reflection on the Technology* by José Ortega y Gasset.<sup>iv</sup>

To date, a number of misconceptions and rigid categories persist in the field of theory, making it difficult to see the music of the 20th and 21st centuries. This thesis should be dedicated to extended thinking about newer and contemporary music and offering new insights into the relationships between music and technology in the music of the previous and the present century.

Foreign publications focusing on the relationship between music and technology are scarce. Usually they contain either disparate or highly specialised topics that they can hardly help create a consistent view of the issue. One example is the collection of reports and papers *Music and technology*<sup>v</sup> from the eponymous event organised by UNESCO in Stockholm in 1970. Other collective monographs in this field are similarly fragmented, e.g. *Music and Technologies* (2013)<sup>vi</sup> and *Music and Technologies 2* (2014)<sup>vii</sup>, containing studies in computer music as well as architecture. Reference authorities, such as the books from the edition *Oxford Handbook of ...*, are somewhat problematic. In diverse chapters they cover specialised topics, which can be considered less beneficial in view of the general theme of "music and technology". Our thesis offers a selective list of existing "handbooks", which are at least partly related to the issue of the relationship between music and technology.

The sub-discipline of musicology that seems most closely related to the issue is technomusicology. On closer inspection, we find that this is just a Wayne Marshall academic course at Harvard University. The course includes the history of the reproduction of sound, technical sound mediation, soundscapes, radio, podcasting, sampling, mashup aesthetics, video montages (YouTube), DJ mixing, video game design, music design and interactivity.<sup>viii</sup> Although the course draws on the academic literature, its unambiguous focus is practice and the applicability of its methods.

Kiri Miller (Brown University, USA), a technology-oriented musicologist, works on ethnomusicology and focuses on digital games, popular culture and gender studies. Her biggest published achievement is *Playing Along: Digital Games, YouTube, and Virtual Performance* (Oxford University Press, 2012). As a teacher she offers the *Music and Technoculture* Ethnomusicological Seminar at Brown University. Its content is ethnographic approaches to technologically-mediated musical practices. She focuses on recording studios, electronic dance music, mass media, digital gaming, virtual reality spaces, multimedia installations and popular music reception. The newly-emerging field of ludomusicology is further represented by Karen Collins and Melanie Fritsch.

An important discursive framework for the selected focus is social theory. Collins and Sherman<sup>ix</sup> confront several theories of the relationship between man (society) and technology. Our thesis enters following discourses: technological determinism based on the ideas of Marshall McLuhan, Paul Levinson's conditioning<sup>x</sup>, Wiebe Bijker's technological constructivism (SCOT)<sup>xi</sup> and probably the best compromise conception of the relationship between man and technology suggested by Bruno Latour and his Actor-Network Theory (ANT).<sup>xii</sup>

Timothy D. Taylor classifies socio-technological theories in one of the most striking publications on our subject, *Strange Sounds: Music, Technology and Culture*<sup>xiii</sup> in the following manner: 1. A Voluntarist Approach, 2. Technological Determinism, and 3. Technological Somnambulism (Langdon Winner). Our position is closest to a voluntarist

approach, taking into account the possibilities and arguments of technological determinism. In our opinion, point 3 is too distant from reality and its rational reflection.

Menser and Aronowitz<sup>xiv</sup> define three basic methodologies for examining the position of technology in society, not only as an artefact, but also as part of practice: ontological, pragmatic and phenomenological. For the purposes of further explanation, we will focus on the first two points, which we perceive as key functions of technology in the music of the 20th and early 21st century. Based on the above-mentioned methodologies, Menser and Aronowitz describe three kinds of human, culturally-determined actions related to technology: interaction, knowledge and experience.

Like Latour, they arrive at a model of a dynamic closed system in which technologies are acculturated in societies through human action, and at the same time they generate new needs and social spaces for man.<sup>xv</sup> It is the ontological and especially the pragmatic function of technology in contemporary music that are the two basic aspects of exploration used in this work.

Another noticeable and very strong tendency in foreign academic circles is the move from exploring pure music as an isolated artistic medium to transmedia overlaps and multimedia complexes. The extension of reflections on music towards multimedia can be found in the French (Michel Chion and Jean-Yves Bosseur), the German (Dieter Daniels) and the Anglophone environments (Claudia Gorbman, Jamie Sexton, Randall Packer and Ken Jordan).

In the Czech environment the issue of the relationship between music and technology in the post-war period was first opened up in the field of "cybernetic" or electroacoustic music. More generally, a substantial part of the discourse is limited to electro-acoustic music (EA music) from the 1950s to the 1990s. After pioneering publications by members of the Cybernetics Commission of the Union of Czechoslovak Composers, Vladimír Lébl<sup>xvi</sup> and Eduard Herzog<sup>xvii</sup>, these were mainly the works of Miroslav Kaduch<sup>xviii</sup>. In the new political and social conditions of the 1990s, a number of Daniel Forró's publications<sup>xix</sup> published by Grada in the edition Musitronics have excelled in their complexity. Perhaps the most comprehensive review of the development of Czech EA music has been written by Lenka Dohnalová<sup>xx</sup>, although we lack the development of EA music in Czech Television and in film, which is one of the key chapters in its development. Michal Rataj<sup>xxi</sup> in his book focused on radioart rather than EA music. It is understandable from the point of view of his work at Czech Radio 3 (he was a long-time author of the Radiotelier program and curator of the Radiocustica web portal). An important volume edited by Rataj is the collective monograph *Sound to the Head*<sup>xxii</sup> that deals with the phenomenon of acoustic art in its various forms. An extensive organological, respectively an organographical project of the recent past is the two-volume publication *Electrophones* by Milan Guštar<sup>xxiii</sup>. An electronic publication called *Electroacoustic Music*<sup>xxiv</sup> by the author of the present habilitation thesis also has an overview character suitable for educational purposes.

The inspiring synthetic study is the *Technology and Social Functionality of Music*<sup>xxv</sup> by Jiří Fukač. He draws attention to the fact that the discussion of the relationship between music and technology involves so many different and contradictory approaches that it is hard to say anything consistent and homogeneous. Fukač recommends extending the dyad music-technology to the triad of music-technology-man (and his activity). Fukač analyses the problem from three points of view: 1. in terms of technology in the structure of music and its social consequences, 2. music in the structure of technology and 3. the autonomous interaction of music and technology. The most interesting part of the reflection is the third section about the potential existence of a blend of music and technology ("musicotechnology"). While this proposal could seem speculative, it may best reflect reality, especially from the perspective of our current reading. While Fukač writes in 1972 that techno-musical practices do not yet create a continuum, but are too important as a phenomenon with developmental potential to simply be ignored, at the moment we can only confirm this claim as a starting point for our thesis. Indeed, music cannot be separated from technology, both at the level of thinking and the resulting musical structure, at the level of interpretation and distribution practices or mere consumption, which has a significantly active character.

An ambitious academic project linking different perspectives was the *Industry and Technology Symposium in Modern Czech Culture*, organised by the Institute of Theory and History of Art of the Czech Academy of Sciences in Prague in 1985.<sup>xxvi</sup> Music was represented only by two contributions, one of them being *Technology and Musical Sensibility* by Ivan Vojtěch. The author points out the fact that the technology of 19th century industrial society was immediately reflected in musical thinking and its theoretical reflections. Since Hanslick and Helmholtz, music has been understood as a rational, mechanistic, causal structure whose historical development can be seen as "*the process of increasingly sophisticated, more extensive and differentiated control of sound material in its objective structurally binding possibilities*".<sup>xxvii</sup> He also talks about the concepts of simultaneity, synaesthesia and spatialism, which we are today able to classify under multimedia. The merit of Vojtěch's essay is a reference to E. A. Poe and his *Philosophy of Composition* (1846), on the basis of which he understands art as a relationship of mathematical construction and creative metaphoric mode, that is, the relationship between a calculable rational structure and the field of living meanings.

Another comprehensive area of research into the relationship between music and technology is the issue of music and media. Research in this area has been developing in the Czech Republic since the 1990s, when a comprehensive collective monograph entitled *Music and Media: The Guide of a Musicologist*<sup>xxviii</sup>, which, with the help of institutional "insiders", was created under the leadership of Jiří Fukač. It described the practice of the contemporary dominant mass media (radio and television). In theoretical aspects, it followed up on the sociological research of Th. W. Adorno, W. Benjamin, K. Blaukopf, V. Karbusický and the philosophical explorations of M. McLuhan, V. Flusser, J. F. Lyotard and others.

More recently, a comprehensive research on the relationship between music and technology has been conducted by the Center for Basic Research at AMU & MU, "Research on the Functions of Technology in the Creation and Performance of a Musical Work", operating in 2005-2008.<sup>xxix</sup> Its contribution lay mainly in the extent of the covered issue, as it covered research in the field of performing arts, and less in the depth of the examination of individual art. From the point of view of outputs, music was represented quite marginally and in selective topics (e.g. the relation between operetta and the musical). Therefore, the project results were not very beneficial for the purposes of our thesis.

A newer contribution to the discussion of technology (media) and art (including music) is the collective monograph of fourteen authors *Art and New Media*<sup>xxx</sup>, which emerged from the Department of Musicology of the Faculty of Arts of Masaryk University. The enormous interest in this issue in the Czech environment is evidenced by the fact that the publication and its subsequent reprint were sold out within a few years.

The distinctive domain of the cognitive reflection of music and sound in the media consists of film music, game music or specific types of heteronomously functional music. These types of music have long been overlooked or circumvented by musicology. The problem lay especially in the traditional understanding of music as a closed work of art, which can be analysed formally, respectively structurally, with overlaps to aesthetic and artistic value judgments. Nevertheless, the area of functional music poses quite different questions. It deals mainly with problems of sound/music dramaturgy composed of more media (intermedia or multimedia), problems of music psychology and psychoacoustics (work with emotions, manipulative/persuasive techniques, etc.), new forms of sound and music structuring in time and space (especially in game music), sound as part of interactive/responsive systems, etc. So far, the sphere of perception of music related to sociological research into the audience and its behaviour (not only in concert halls and theatres, radio and television, but also in public spaces) is a relatively neglected area. Particularly in the field of game studies, sound and music play a major role not only in the construction of meaning (as in film), but also in constructing space-time, enhancing the immersion and flow of the player.

Further literature is to be found in lower hierarchy categories such as electroacoustic music, soundart, radioart, film music, game music, etc. At this level we find historically solidly developed discourses with their own communities of experts and established publication channels. Journal articles and separate studies are the typical outcome of these sub-disciplines. Czech books reflecting on the theory, aesthetics and history of these categories can be found sporadically, and there have been only a handful of them in the past half century.

The strongest motivation for cognitive reflection in the field of musical technology is demonstrated mainly by practically oriented authors, i.e. academically active composers and musicians. The last significant works in this section include at least the theoretical

production of JAMU in Brno and HAMU in Prague; let us mention at least the theoretical production of JAMU and HAMU, in the case of JAMU the texts of Ivo Medek dedicated to multimedia in connection with the works of Alois Piňos (e.g. together with Markéta Dvořáková *Multimedia Work - Theory and Practice*)<sup>xxxix</sup> or the habilitation thesis by Dan Dlouhý (*Computer assisted algorithmic composition*)<sup>xxxix</sup>. In the case of HAMU, these are the works by Michal Rataj and his students (e.g. *Digital Technology in Music Creation for Acoustic Instruments*)<sup>xxxix</sup>.

What is largely lacking in the field of musicology are synthetic works that could break the boundaries of individual lower categories and rise to more universally-valid conclusions and theories. We find this ability sporadically and rather in those whose primary focus is not musicology. The most valuable insights of this type are found in the field of philosophy, sociology or aesthetics. Obviously, this situation is caused by the inability of analytically and narrowly-oriented musicologists to move away from a quantity of detail towards a more general view of the whole issue. Knowledge of detail is certainly crucial, but always only within a true understanding of the whole. It is reasonable to assume that it is the ever-deepening specialisation in musicology that challenges the vision of the whole and which also makes it difficult for professionals to communicate with a wider audience. Therefore it is necessary to appreciate the transverse views of those who do not both feet stuck in details and are able to perceive the connections of phenomena across rigid categories. The case studies included in this habilitation thesis apply to such transverse views.

The real problem in exploring the relationship between music and technology is its character as a "buffer zone." It is a rarely conquered area between the external approaches of non-musicologists (philosophers, sociologists, aesthetics, psychologists, etc.) and musicologists limited by the internal methodology of their own field. With a certain degree of exaggeration and simplification, one could say that the sparsely populated interdisciplinary space between music and technology is colonised by intellectual adventurers with an over-universal focus on the one hand and those with an overspecialised education on the other.

#### **4. Assumptions and Objectives of the Thesis**

This thesis is the result of a long-term study of the musical thinking of elite representatives of Euro-American artificial music of the 20th and early 21st century. Their intellectual outcomes have a dual characteristic: theoretically-formulated individual poetics and musical works. Usually, both worlds are interconnected because each composer is an intellectual who expresses himself in both media (text and music) simultaneously.

Perhaps the most important task of this treatise is to present in Czech musicology an as yet absent synthetic study of the relationship between technology and contemporary music. Based on interpretations and case studies of the thinking of particular composers, we will try to abstract the basic terms (or keywords) that appear to be dominant in this area. Based on

these features, we will then proceed to build a synthetic image of technologically determined music, in which we will try to identify more general tendencies and strategies.

What hypotheses precede the subject?

- 1) It can reasonably be assumed that electronic technology and its rapid development caused a radical change in the musical thinking of the 20th and early 21st century.
- 2) The electronisation and digitisation of music has led to redefining or questioning the function and nature of authorship, musical instruments, interpretation and the originality of the work.
- 3) Efforts to make creative use of new technologies have been driven by external and internal factors.
- 4) Musical thinking reacts sensitively to changes in thinking, society and technology, so these changes should be reflected in the music itself.
- 5) Just as intellectual attitudes to technology during the 20th and early 21st century have undergone a shift in particular towards a critical attitude, we assume that we will also find critical works in music.
- 6) Technology in music cannot be eliminated. Or can it?

## **5. Conclusions and Results of the Research**

A treatise on the relationship between man, music and technology was opened by Heidegger's suggestion of solving the relationship between man and technology in the field of art. Our goal was to explore whether and by what means the music of the 20th and early 21st century have responded to his call.

The cause of this thesis is the fact that so far there is no satisfactory synthetic treatise on the role of technology in artificial music in Czech musicology, in terms of musical aesthetics, or the philosophy of music and technology, although there are a number of great works on specialised topics. The purpose of this treatise is to investigate the impact of 20th and early 21st century technologies on the musical thinking of the creators of artificial music.

The aim of this work is to inductively draw general approaches and categories based on historical, theoretical and aesthetic research on the basis of key words and concepts that appear in the network of relations between technologies, music, thinking and action.

1. First, we pose the question of whether there is specifically "human" music in contrast to technology-mediated music. It turns out that music cannot dispense with technique/technology and is even directly dependent on it. Not only are technologies an extension of human perception, thought and action, but music is also an extension of human thought. Some theorists such as Collins and Young (Chap. 1) directly claim that music is a technology; a form of applied instrumental thinking. We can hardly find non-technological music, a sort of Lévi-Strauss "raw" music of Rousseau's "noble savages", because music is a

rational structure of sounding material, and every attempt to (re)produce it is necessarily tied to controlling the rules of that structure and the performing instrument (even if only a human voice). If we talk about post-technological music in this thesis, we do not mean music that arises without the use of technology, but music whose authors are critical of technology-determined music (just as postmodernism is not necessarily a negation of modernism and Post-Internet art is not a denial of the existence of the Internet).

2. In the relationship of man as a creative subject to the use of technology in music, we propose the identification of four basic attitudes: techno-utopic (or techno-optimistic), technorealistic, techno-sceptic, and post-technological. In the introduction we propose a different degree of participation of the technique in music, respectively the degree of the author's emphasis on technology in the process of creating music, which overlaps with two existing sociological theories, with different forms of technological determinism and, at the same time, the theory of remediation by Bolter and Grusin. In addition to theoretical explanation, these basic attitudes are exemplified by short studies of the poetics of representative music composers and theorists.

3. The twentieth century and the beginning of the twenty-first century are perceived as a great developmental arch, in which experimental and empirical verification of the possibilities of analogue and digital (that is, generally numerical, not just binary) technology for the purposes of music creation. Today we see that electronic and digital technologies have not become the only possible form of music, as it might have been perceived in the 1950s. On the contrary, their onset drew attention to a number of constants that cannot be eliminated in music - as a specific form of social interaction. Only because of their temporary absence or relativisation did music culture realise their indispensability. These are especially the following components of the music process: 1. visualisation/theatricality of music; 2. performativity of music (presence of player on stage); 3. a certain degree of imperfection; 4. interactivity between audience and player, machine and live player; 5. the role of authorship and the 'closedness' of a work; and 6. the "slowness" of technology development required for the development of virtuosity.

As we have found, the technology has a major impact on the following music areas:

## **I. MUSIC CREATION AREA**

**1. Creative intention, invention and imagination.** Technology must not become their determinant, but must lead to their liberation and strengthening. Perhaps the greatest threat is the loss of the meaning of musical creation, as it cannot be delivered to music externally by new technologies despite contemporary expectations, but must be an expression of the author's inner will. The technique must be grasped creatively and become an instrument of the author's intention, invention and imagination. While in the role of invention and imagination, technique played a key role, especially in the inter-war avant-garde of the 20th century, its pragmatic function in the electro-acoustic music of the second

half of the century is not so perceptible. Although its sound processing capabilities have contributed to the development of the timbre component of music, the difficulty of manipulating techniques, especially in the early decades of EA music, became a barrier to free creativity. It has been bridged by the collaboration of composers and technicians who, however, represent two different worlds of thought, or even two cultures. This gap was possible to overcome gradually by the technical training of composers. In recent years, a peculiar approach has been the technical ecology that consciously renounces advanced technology in the creative process in favour of developing invention and imagination through deliberately simple resources.

**2. Historical memory and the productive function of historical amnesia.** As the 20th century has shown, recording technology and storage media are becoming serious competition for new music production. While music composed up until the first third of the 19th century was performed and then forgotten (despite being fixed in sheet music), the arrival of sound recording made the music of different time periods and geographical locations permanently present, thus incredibly overloading contemporary music culture. We therefore argue that while the absence of music provokes the need for new music, supersaturation by the music of all mankind functions as an external inhibitory factor of creativity and contributes to the loss of the meaning of musical creation. What remains is the individual will and need of the author to express himself through composed sounds. These two factors, external and internal, are two opposing forces.

**3. New composing strategies.** Several strategies are being used to create new music in accordance with the composer's attitude to music. Typical for realists is the search for a subordinate pragmatic function of new technologies in the process of musical composition. These technologies and their processes then become an organic part of the work, without the need to impose their logic on the work or to draw attention to their existence in a special way.

As we try to prove in several examples (Chap. 5.4.2), another important factor is the adaptation of technological models in "live" music. Technology and media bring their design logic to human action and thinking, which can later be expressed in music, for example in the form of loops, composed additive synthesis, or remixing.

The risk factor of the new creation is the supersaturation of new technologies. This conditions a technological ecology and an awareness of the fluidity and transience of means. Thus, there are strategies of recycling not only existing audio material (such as sampling or plunderphony), but also audio hardware (old printed circuit boards and used electronic components) often in conjunction with amateur handicrafts or improvisation.

**4. Emphasis on material** can take several forms in 20th and early 21st century music. Either its cause is the pursuit of the objectivity of the music (i.e. the tendency to eliminate the author's post-romantic subjectivity, as pointed out in Chap. 3.2) or a reminder that

electroacoustic music was created to manipulate sound as a material that has so far resisted manipulation. From today's point of view, the revision of the position of electronic technology from an ontological function towards a pragmatic one is important. To put it simply, electronic technology has only contributed primarily to the exploration and composition of sound. This also established a new paradigm of sonic art. Even if now hypothetically all electronic technologies completely disappeared, there would have been a change in the musical thinking of the 20th and 21st centuries. Undoubtedly, electronic technology has primarily led to the discovery of new timbre possibilities, or a new methodology of working with audio material that has enriched composed acoustic music.

## II. MUSIC COMMUNICATION AREA

1. **The disintegration and relativisation of components of the music communication scheme.** Individual parts of the linear communication transmission model based on Shannon and Weaver are either weakened, replaced or directly eliminated. Another problem is connected with the isolation of the author, who strives to find an audience for his complicated production. In addition, the audience for acousmatic music is newly confronted with a "dead" technology that deploys music from action and sound from its source, which is not only a transgression against the logic of interpretation, but also a paradox due to traditional experience. The question arises as to whether the real (not utopian) future of EA music has been rescued by the onset of non-artificial music that has earned its resources, but with regard to listeners. The breaking up (fragmentation or dislocation) of the space-time production-reception framework in which music is simultaneously produced and experienced as a shared experience "here and now" is a major problem that disturbs the established pattern of social communication and challenges the current culture.

2. **The instrumental problem.** Man changes the world around him primarily through physical action. Our creative interfaces are therefore physical in nature. This was the source of all the older music until the 20th century. It used physical tools or the human voice. Digitised music becomes an instrument of the intellectual, formal and symbolic manipulation in virtual space. Due to the complexity of the new musical and sound structures, these manipulations take place in deferred time, and much of the process remains hidden for the audience. This mediated experience has a detrimental effect not only on the audience, but also on the author/performer of the music, losing the possibility of direct communication. Therefore, in recent years, new interfaces have emerged (which can traditionally be called musical instruments) for live performances that can be used to re-establish direct communication between the two parties.

3. **Music as a subject and object of communication.** In Chap. 4.4 we tried to elaborate the problem of the relation of music to different types of communication situation and to propose their brief typology. As it turns out, music is not only a subject of communication, that is a medium of communication encoding emotions or thoughts, but also an object of communication - when it is communicated and distributed in certain ways. It becomes an

object of sound media, distribution media, recording media and reflection and metareflection media.

### III. THE AREA OF MUSIC ARTEFACTS

1. **The problem of the authenticity of technological music.** A work that arises in accordance with the author's thinking and conviction, using adequate means to fulfil the author's intention, is authentic. Such a work is structurally organic and consistent. From the point of view of the creative means used we can consider authentic music as based on the possibilities and logic of the instruments used. Nevertheless, in the case of technologically produced music, we often encounter the principle of simulating other (older) instruments. From this perspective, the computer simulation of a symphony orchestra has a lower value than for example the connection of granular synthesis with a probability count.

2. **The characteristics of a digital artefact.** In Chaps. 4.5 and 4.6 we relied on the theoretical observations of S. Cubitt and M. Knakkegaard. While the first explores the features of digital work, the second deals with its essence in the process of forming digital music. Especially valuable is Knakkegaard's observation that, due to its non-material nature, digital work is not reproduced, but constructed over and over, which corresponds to Cubitt's definition of the non-identity of the code and the resulting artefact.

3. **Forms of materialisation of music.** One of the most interesting contributions of this thesis could be the discovery that music can materialise in other media than in sound. Examples include image, sculpture and architecture (Chap. 4.8). Although some of the transcoding examples go back to the analogue era, it is one of the basic principles of new media, illustrating the above-mentioned principle of the non-identity of digital code and artefact that arises as its interpretation through the selected interface. Digitality dissolves all existing media and types of art into the simplest binary code to make it possible to construct anything different or identical to the original input. However, fluidity and transience as one of the basic principles of digital forms, in a sense, also applies to creative means and technologies. The rapid sequence of their discoveries often prevents their becoming established in musical history and prevents the development of their full potential. The result is a rapid change in technology, the possibilities of which are not sufficiently exploited and that do not allow the emergence of virtuoso approaches. In this sense, the rapid innovation tendencies can be considered rather a negative phenomenon damaging the quality of musical culture.

### IV. THE PHILOSOPHICAL AND SOCIAL CONTEXT OF MUSIC

At the end of the modern era we can follow up on J.-F. Lyotard (in Chap. 5.4.1) in observing a situation where technological development does not meet the needs of artists but rather its own needs. The subject of change is the technology itself and the need and its application are additionally created. Again we encounter the problem described by P. Boulez (Chap. 5.2.3), when technology precedes the need for artistic intention, invention and imagination

(Chap. 5.2.1). Technology is a manifestation of modern thinking and therefore it is interesting to follow its development and use in postmodern times. We believe that there is no elimination of technology in society, but rather a reassessment of its role. While modernity has sworn by technology as the future of music, postmodernism understands it as a necessary but quite common part of the choice of resources available. We often encounter a "hiding" of technology, adopting its principles in live, non-technological music, and creating an intuitive user-oriented interface design. The technology returns to its instrumental role and becomes a means of realising human creativity. While in the modern era man is the object of the instrument/machine, in postmodern times he regains his lost domination as its subject. In the most recent period, which is difficult to grasp because of a near-zero historical distance, the return of certain techno-optimistic tendencies in musical art can be observed. These tendencies in art theory are referred to as neo-modernism or altermodernism (Chap. 3.4).

It is very likely that the relationship between human and technological roles in the music of the 20th and early 21st century cannot be fully defined. Rather, it appears to be a dynamic interaction of the three areas, in which one prevails on the basis of current social, cultural or aesthetic conditions. The aim of the habilitation thesis is to articulate and analyse these changes.

## References:

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- <sup>i</sup> Compare also FUKAČ, Jiří. *Pojmosloví hudební komunikace*. Brno: Masaryk University, 1991, p. 53.
- <sup>ii</sup> SOURIAU, Anne. Technika [entry]. In SOURIAU, Étienne. *Encyklopedie estetiky*. Prague: Victoria Publishing, 1994, p. 858.
- <sup>iii</sup> MÜK. Technika [entry]. In *Velký sociologický slovník*. II, P-Ž. Prague: Karolinum, 1996, pp. 1278-1279.
- <sup>iv</sup> HEIDEGGER, M. *Otázka techniky*. Prague: Oikúmené 2004; ORTEGA Y GASSET, José. *Úvaha o technice a jiné eseje o vědě a filosofii*. Prague: Oikúmené, 2011.
- <sup>v</sup> Paris: La Revue musicale, 1971.
- <sup>vi</sup> KUČINSKAS, Darius a Stephen DAVISMOON. *Music and technologies*. Newcastle upon Tyne: Cambridge Scholars Publishing, 2013.
- <sup>vii</sup> KUČINSKAS, Darius a Georg KENNAWAY. *Music and technologies 2*. Newcastle upon Tyne: Cambridge Scholars Publishing, 2014.
- <sup>viii</sup> *Music 190r: Technomusicology* [online]. [Cit. 5. 9. 2016]. URL: <http://wayneandwax.com/academic/Music190r-syllabus.pdf>.
- <sup>ix</sup> COLLINS, Steve – SHERMAN, Young. *Beyond 2.0: The Future of Music*. Equinox Publishing, 2014.
- <sup>x</sup> WINNER, Langdon. *Autonomous Technology: Technics out of Control as a Theme in Political Thought*. Cambridge, MA: MIT Press, 1977, pp. 192-210.
- <sup>xi</sup> PINCH, Trevor – BIJKER, Wiebe. The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. In Wiebe Bijker, Thomas Hughes and Trevor Pinch (eds). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 2012, pp. 17-50.
- <sup>xii</sup> Comp. CALLON, Michael – LATOUR, Bruno. Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So. In Karin Knorr-Cetina and Aron V. Cicourel (eds). *Advances in Social Theory and Methodology: Towards an Integration of Micro and Macro-Sociology*. Boston: Routledge, 2014, pp. 277-303; LATOUR, Bruno. The trouble with Actor-Network Theory [online], [cit. 8. 10. 2015]. *Philosophia* 1997, 25. URL: <http://www.ensmp.fr/~latour/popart/p67.html>.

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- xiii TAYLOR, Timothy D. *Strange Sounds: Music, Technology and Culture*. NY, London: Routledge, 2001, p. 26.
- xiv ARONOWITZ, S. – MARTINSONS, B. – MENSER, M. (eds.). On cultural Studies. In *Technoscience and Cyber Culture*. NY: Routledge, 1996, s. 15. cit. in Lysloff, René T. A. – Gay, Leslie C. (eds.). *Music and Technoculture*. Middleton: Wesleyan University Press, 2003.
- xv "Technologies become imbedded in cultural systems and social institutions, which, in turn, are reconfigured by those same technologies." Ibid., p. 8.
- xvi LÉBL, Vladimír a Ladislav MOKRÝ. *Nové cesty hudby: sborník studií o novodobých skladebných směrech a vědeckých názorech na hudbu*. Prague: Státní hudební vydavatelství, 1964; LÉBL, Vladimír. *Elektronická hudba*. Prague: Státní hudební vydavatelství, 1966.
- xvii HERZOG, Eduard. *Nové cesty hudby: sborník studií o novodobých skladebných směrech a vědeckých pohledech na hudbu*. Prague: Editio Supraphon, 1970.
- xviii KADUCH, Miroslav. *Záznamová technika hudby XX. století*. Ostrava: Městské kulturní středisko v Ostravě, 1982.; KADUCH, Miroslav. *Česká a slovenská elektroakustická hudba 1964-1994: skladatelé, programátoři, technici, muzikologové, hudební kritici, publicisté: osobní slovník*. Ostrava: Miroslav Kaduch, 1994.; KADUCH, Miroslav. *Vývojové aspekty české a slovenské elektroakustické hudby*. Ostrava: Miroslav Kaduch, 1997.
- xix FORRÓ, Daniel. *MIDI: komunikace v hudbě*. V Praze: Grada, 1993. Musitronika; FORRÓ, Daniel. *Počítače a hudba*. Prague: Grada, 1994; FORRÓ, Daniel. *Domácí nahrávací studio*. Prague: Grada, 1996. Musitronika; FORRÓ, Daniel. *Svět MIDI*. Prague: Grada, 1997. Musitronika.
- xx DOHNALOVÁ, Lenka. *Estetické modely evropské elektroakustické hudby a elektroakustická hudba v ČR*. Prague: Univerzita Karlova, 2001.
- xxi RATAJ, Michal. *Elektroakustická hudba a vybrané koncepty radioartu: problematika vymezení tvůrčích pozic v prostředí akustických umění z pohledu domácí scény radioartu*. In Prague: Kant - Karel Kerlický for AMU, 2007. Disk, sv. 3.
- xxii RATAJ, Michal. *Zvukem do hlavy: sondy do současné audiokultury*. Prague: Akademie múzických umění in Prague, 2012.
- xxiii GUŠTAR, Milan. *Elektrofony: historie, principy, souvislosti*. Part I, Elektromechanické nástroje. Prague: Uvnitř, 2007 and Part II, Elektronické nástroje. Prague: Uvnitř, 2008.
- xxiv FLAŠAR, Martin. *Elektroakustická hudba* [online]. 1 ed. Brno: Masaryk University, 2015 [cit. 2016-08-18]. Elportál. URL: <http://is.muni.cz/elportal/?id=1308636>.
- xxv FUKAČ, Jiří. Technika a sociální funkčnost hudby. *Opus musicum*, 1972, No. 2, pp. 33-39.
- xxvi *Průmysl a technika v novodobé české kultuře: [sborník symposia pořádaného Ústavem teorie a dějin umění ČSAV ve spolupráci s Národní galerií v Praze v rámci Smetanovských dnů v Plzni ve dnech 14.-16. 3. 1985*. Prague: Ústav teorie a dějin umění Československé akademie věd, 1988.
- xxvii VOJTĚCH, Ivan. Technika a hudební senzibilita. In *Průmysl a technika v novodobé české kultuře, op. cit.*, 1988.
- xxviii FUKAČ, Jiří a Petr MACEK. *Hudba a média: rukověť muzikologa*. Brno: Masaryk University, 1998.
- xxix Annual report of the Center for Basic Research at AMU & MU [online]. [Cit. 10. 7. 2017]. URL: <https://www.amu.cz/cs/ovvp/msmt/programy-podpory-vav/centra-zakladniho-vyzkumu/dokumentace/vyrocní-zprava-centra-zakladniho-vyzkumu-amu-mu-za-rok-2005>.
- xxx FLAŠAR, Martin – HORÁKOVÁ, Jana – MACEK, Petr (eds.). *Umění a nová média*. Brno: Masaryk University, 2011.
- xxxi Ibid.
- xxxii DLOUHÝ, Dan. *Počítačem podporovaná algoritická kompozice* [habilitační práce]. Brno: JAMU, 2013.
- xxxiii RATAJ, Jakub – AGOSTINHO, Gilberto. *Digitální technologie v hudební tvorbě pro akustické nástroje*. Prague: AMU, 2016.