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On the Relationship between Art and Technology in Contemporary Music

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Abstract

This article starts with the question, whether different epistemological and practical objectives in art and technology are responsible for the problems which can be observed in present Media-art. Therefore, we first demonstrate some traditional objectives of art, especially the position of the so-called Frankfurt-School, according to which art is diametrically opposed to technological attitudes and claims since art has to express alternative ways of perceiving and interpreting the world. In contrast to this, we argue that techniques and technological states always have influenced the creative act. By demonstrating this effect in contemporary music, we describe some of the problems which arise when artists use computers and, furthermore, we put for discussion some ideas which may lead to a more creative use of these systems.

Keywords

aesthetics, technology, philosophy of techniques, criteria of validation, art-making, contemporary music, computer-systems, media-art

1. Introduction

In the discourse of philosophical aesthetics during the last two centuries, it is evident that the question of the essence of art has played a central role. In this tradition, art was not understood as "something constructed". 1 Instead, art was integrated into the conceptual

world of epistemology through the philosophical aesthetics developed in the major philosophical systems. Accordingly, within this metaphysical tradition, art was attributed an exploratory, interpretative and epistemological function, insofar as it was assumed that truth could appear in a given work.

Modern theories of art have freed themselves from this philosophical bondage, especially from the metaphysical objective of expressing truth2 by art, tending instead to orient their approaches toward empirical sciences. Thus at the centre of reflection on theories of art is less a work's ontology, but rather its experientiality3, that is the way how it will be perceived and interpreted. Concomitantly, concentration has shifted to specific aspects of art, like the aesthetic use of signs, schematisation modes, or the message of art, and thus the metaphysical construct art has been separated into definable, explainable components. The production and reception of art, the characteristics of its medium, its capacity for communication, its effective possibilities and their consequences all these considerations have become points of reflection which can be analysed independently.

This is the context into which the present essay fits. Consequently, it is not the relationship between technology and art in general which will be treated; rather, we want to examine critically the interaction of artistic and technological perspectives and approaches. In this discussion on using technology in art, we will concentrate primarily on the aspect of artistic creation to document difficulties and possibilities and to point out relationships with the epistemological interests4 and criteria of validity5 in each discourse area.

This implies the following procedure : First, we will present and analyse critically the hypothesis of the "two cultures". Then, we will examine how, in an empirical analysis of partial aspects of art, connections to technology can be established which render questionable the strong discrepancy of the criteria of validity in these two domains. Here, we will take the use of technology in contemporary music as an example to show in what way artistic objectives can be realised using technological possibilities and to show what problems arise. We will then demonstrate how these difficulties result from the implicit acceptance of technological habits by artists. And finally, we will discuss in which way technology can be used in art without giving up aesthetic intentions and criteria.

2. Interpreting the World, or: the "Two-culture Problem"

In writings of early Greek philosophers, references can be found to different ways of interpreting and approaching the world. Aristotle, for example, differentiates between a theoretical, a creative, and a practical orientation. According to this, the goal of theoretical science is the search for truth; the goal of practice ("Praxis") is the act or the result of acts as well as the proper way of acting ("das richtige Tun"); the goal of poiesis is making and producing. Analogous to this early distinction are equivalent attempts at definition, which can be found up to this day. Science has been primarily imputed theoretical epistemological ideals whose aim was finding truth. Technique6 has been characterised as principally practical, being oriented on criteria of usefulness. And art was attributed an individually expressive, sensually and emotionally characterised exploration function7, beyond logocentric or expediency potential. In this way, and especially from a metaphysical perspective, art came al- most naturally into contradiction with science and technique. Especially in the diagnoses of philosophical cultural criticism, as they were developed by Heidegger and Adorno, for example, the distinction between artistic expression and technological rationalism gained particular meaning. Technique came to be interpreted as the expression of a totalitarian

MAN8 against which only art could set a different accent, for art was thought of as being capable to express undefinable, unpronounceable aspects of the world which escape from technological control.

In the context of this interpretation, technique was characterised as follows: The fundamental paradigm of all technical development is the idea of Verfugbarmachung (making something available). This refers not only to the domination of nature but also to the control of social processes. A related expectation is that technique always has to serve a purpose. Technological products must be useful, which means that in practice, they must be manageable as well as utilitary. According to exponents of cultural criticism, with the spread of technique the danger increases that the whole world, including human beings, become nothing more than an object of technical availability. Increasingly within our culture, the only possible paradigm and profitable way of interpreting and approaching the world appears to be an orientation on exclusively rationally determined expediency.

In opposition to this sort of technological domination by technique and associated attitudes, Adorno interpreted art as the only possible alternative. He pointed out that epistemological objective of art9 always was diametrically opposed to that of technique: While technique aimed at a general ordering and a global control, art - in contrast - revealed individual and particular aspects of the human existence. In artistic expression, new views of the world which contrast with general paradigms of technology could be experienced and articulated. In its lack of purpose, art aimed not at making something available, but rather, in its very distance from the attitudes proper to technique, it referred to alternative modes of individual and cultural ways of living. Points of view similar to these are also found in the works of the philosopher Jurgen Habermas, who undertakes a fundamental differentiation between the system-world ("Systemwelt") and the life- world ("Lebenswelt")10. These categories imply an important classification for our discussion: Art is described as an essential aspect of live-world, while technology is understood as a pillar of the system- world. The criteria of validity differ accordingly: While art is attributed being capable to express what is significant for the individual, the paradigm of technology includes rational purpose, goal orientation and the idea of feasibility. Habermas makes evident the extent to which these two discourses exert a mutual influence; nonetheless, the epistemological and practical objectives of the two are diametrically opposed in his writings. Thus, an orientation towards purpose, utility, and availability appears here as characteristics of technique, while art is described as aiming at individual expression, authenticity, and by its attempt to escape from the purpose-oriented paradigm of availability by using pre-rational and non-predicative ways of interpreting the world.

The dichotomy between the discourses of art and technology which is assumed in such theoretical approaches, would have consequences for the anticipated synthesis in the domain of media art: - either the synthesis cannot be realised because the different epistemological objectives and ways of interpreting the world will never fit together;

- or art would pay for the synthesis with the loss of its particular criteria and its specific exploratory function, a situation tantamount to the burdening of artistic intention with the paradigms of technology. In the following, let us examine more closely the suppositions associated with such a differentiation. As we indicated in the introduction, most classic attempts to define the discourse of art suffer from the fact that the evaluation of arts usually is undertaken from the perspective of art reception. Usually, an implicit ontological assumption lies at the base of such analyses. Combined with this is the claim for autonomy in art11,

which increasingly has become dubious and was identified as a residue of bourgeois culture. The institutionalisation of art as a socially autonomous discourse was and is combined with exclusionary practices, which have a constituting function for every discourse. This process of institutionalisation presupposed clear criteria, which were intended to determine if a work is considered to be art or not. With the post-modern widening towards triviality, however, exactly these exclusionary institutionalising practices became questionable and with them the associated criteria of validity. Art as an independent domain, as it appears in the works of Heidegger, Adorno and even Habermas, looses its clear boundaries - its function in the culture is more and more characterised by a tendency towards a global Asthetisierung of our life-world, which means that phenomena of our everyday life are regarded under an aesthetic perspective. This disintegration is combined with an increasing critique of the characteristics which were ascribed to art wi- thin the metaphysical tradition. More particularly, this disintegration calls into question the capability of art to exist independent of other social discourses and to develop its autonomous (or even "free") forms of interpretation and inquiry of the world, which go beyond the ruling orientations. The dictum of originality, individuality, and authentic expressiveness, as it appears as a characteristic of art in Adorno's and Habermas' works, for example, was unmasked as a remnant of a subject-oriented view of the world. Such a view fails to recognise that the subject, which was once considered to be autonomous, has long since been completely permeated by all embracing social structures, such as language and the technologically mediated attitude12 of availability and control, to the extent that it is now influenced by them. According to this, the idea of autonomous criteria of validity in art also appears increasingly doubtful.

A similar phenomenon can be observed in the realm of technique. Due to the fact that it permeates all areas of life and influences or even determines the way of acting within the world by shaping cultural interpretation paradigms, it cannot be separated from other social areas by identifying special modes of discourse and particular criteria of validity. Instead, in the so-called information-society, what Adorno and Heidegger had anticipated, begins to take place: The paradigms proper to technique become the general orientation in our culture, penetrating to an increasing degree even areas which previously, as residues, managed to preserve a proper identity and specificity. And this is also true, as we will later see, for art and artistic activity.

3. Art and Technology: Intersections and Interconnections

We have thus seen that the traditional approaches in philosophical aesthetics and culture criticism - assuming the independence of claims and attitudes in technology and art, become questionable and that the concept of art as an autonomous social discourse, cannot be maintained. For that reason, we are convinced that in order to ensure an analysis of the reciprocal pervasion of conceived goals, interpretation paradigms, and the associated lifestyles, the examination of the relationship between art and technology must take place on a concrete level. In such a limitation of our discussion, a glance at the creative process proves to be fruitful, for here immediate references can be observed. Here, in particular, we may gain an impression of the close connections between technology and art which are a further indication of the brittleness of an overly rigid boundary between both areas, as we will demonstrate in the following.

In contrast to the metaphysical tradition, in the early history of philosophy, especially when looking at the Greeks, the intimate connection between art and technique in the creative process was an important theme. Here, the separation between ars and techne represented

more a nuance than a fundamental difference. Weibel, for example, referring to Aristotle, points out the coupling of techne with the concept of creation. According to this, technique aims not only at imitating nature, but also at creation13 and at creative modification of aspects of the world. Technique is a social act: It is to be "interpreted as a dynamic process, as working and doing, as making and creating."14 In its creative dimension, technique refers not only to the realm of necessity and control but also to the realm of freedom. It is not per se the form of expression of an unconditional will to rationality and rationalisation which aims at making everything available; it can also contribute to overcome given states and structures15. Technique can mask the truth just as well as it can make it evident the creative potential of technique involves the possibility of liberation. If the creative function of technique is taken into account, then "technique-art" is not a contradiction, as is sometimes argued. The traditional confrontation between machine, the mechanical, technique, technology on the one hand and creativity, imagination, and creation on the other hand has led to a point of view from which classical aestheticians could only equate the entry of machines in art with a threatened fall of art. This confrontation, however, was only possible due to the fact that the process of artistic creation and the questions of how and by which means art has been realised were rigorously excluded from the aesthetic discussion. Had these questions been included, it would have been seen that the divergence described above couldn't have been sustained in such a strict sense. As Kant already has pointed out16, every artist takes recourse to techniques or a set of rules and makes use of acquired craftsmanship in order to express an artistic idea. And technical means have always been used in order to express artistic intentions. But even if these conditions have been recognised, they did not play an important role in traditional aesthetics. In this classical view, "the material, the medium of the work of art, the systems supporting the transformation of an object into a painting, or the material medium of a work's construction"17 were neglected compared to the supposed essence of the work of art, its ontological level. But the ontological raison d'etre of the work of art can and has to be traced back to its material structure, to the conditions under which it came into existence. For that reason, we direct our attention to the material fundament of art and to the way how it is constructed, because - as Adorno already said - only in and by its materiality the essence of art can unfold.

4. The Use of Technology and Techniques in Art

Taking these aspects into account the diagnoses, which predict the decline of art in general brought about by confrontation with technique- art or media-art, become relative. That technology and technological products - as well as technique in the sense of a goal-oriented process - always played an essential role in art, becomes apparent in the fact that underlying each work of art, in addition to creative intuition, is also a system of rules and techniques. Thus, that technique is a basic procedure of art is manifest. But also the technological products as well as the historical state of technological development has always influenced artistic ideas and works. Thus, for example, it was only after the development of metal tools that sculpture could flourish, and the painting of the nineteenth century was essentially dependent on the appearance of artificial paints. The problems of contemporary art result less from the use of technology and the use of goal-oriented procedures, than from the fact that the rationalised expediency paradigms of technique begin to suppress artistic criteria and intentions18. And this fear seems especially valid where aesthetic criteria questionable as they may be must yield space to the idea of feasibility and mere sensationalism19.

Thus, we have to consider particularly the gradual changes, the fragilities and the points of intersection which appear in the process of integrating technology into artistic activity, in

order to determine whether the presently generally observable domination by technique narrows this last remaining space to play and explore the free space of human expression or whether there remains freedom for creative innovation and new forms of interpretation.

Before we undertake a concrete investigation on the interaction of technique and art in contemporary music, let us discuss one important aspect which can be seen as a consequence of so-called media art. We have shown that in the course of its history, art has always had a specific relationship to technological development, although in the past, this relationship was primarily characterised by the fact that technology served as an additional resource20. It wasn't until the development of reproduction techniques that the work of art, its originality, and its aura were questioned21. The explosive growth of information and communication technology suggests a further evolution: Increasingly, technology has influenced not only the acquisition of reality through artisanship and handicraft 22, but, spreading in scope, now also influences our images of reality 23, that is the kind of imagination and interpretation of the world, attaining thus a role of central importance in artistic creation, which may lead to a modification of traditional aesthetic criteria with still unknown consequences.

5. The Relationship between Technology, Technique, and Art

In western music history we can identify a similar interrelation of technology and art: particular states of technological development show a close interdependency to respective artistic concepts. Furthermore we can see that standardised procedures always have been an essential prerequisite for any kind of composition. We shall clarify these aspects in the following two examples:

1) The compositional process is subject to various influences and it defies - as any artistic activity - a precise description. Nevertheless, when looking at composition in retrospective, it can be seen that each historical period was characterised by certain compositional techniques which shaped the thinking and acting of composers. Over and over, commonly adopted techniques suggesting new ways of treating the musical material took shape and became subject to historical development. In this process the work of composers always implied a kind of response24 to the currently established repertoire of techniques, which therefore always occupied a central role in artistic work.

2) However, the work of composers is not only determined by different techniques: artistic intentions are influenced as well by technology. This can clearly be seen when looking at instrument making: The development of musical instruments was always dependent on specific technological achievements. One the one hand the technological progress inspired composers, instrumentalists, and instrument makers since it enabled them to think of new possibilities of sound production. On the other hand the concrete musical needs and wishes expressed by instrumentalists and composers led to the development of many musical instruments25.

These two little examples show clearly that the relationship between technology and artistic creation is not simply of a mono-causal nature. Rather we have to assume a dialectical interrelation of the two domains. Certain artistic ideas could not have been realised if certain techniques and technologies were not developed or invented as a consequence of particular demands. In reverse, technology always stimulated the exploration and experimentation with

new artistic concepts. But our short historical review points out yet another aspect: In the past, technology or technological products were only used as a kind of additional resource when realising artistic ideas. Thus they contributed mainly to the craftsmanship. In the context of computer and media art, technology gains a more central role and increasingly influences the intellectual conception of - and approach to - reality. Technology advances from a bare means to the very medium in the process of adoption and interpretation of the world. At the same time we can observe a significant discrepancy between what is technologically possible and what is artistically exploitable. This disparity seems to be responsible for certain undesirable developments as they can be noticed today. We will try to clarify them taking the example of computer assisted music composition and production.

5.1 The Creative Potential of New Technology in Music

The new possibilities offered by technology can be characterised by a notion we encountered already in the discussion on the traditional role of technology: Verfugbarmachung, the act of bringing something to someone's disposal. There are two aspects which become accessible to the composer via new technology: control over potentially all perceptually relevant aspects of the sound material and the possibility to symbolically represent and manipulate musical structures. The fact that sound can be recorded by microphones, distributed via electrical wires or electromagnetic waves, recorded by tape recorders, and reproduced by loudspeakers changes radically the composers access to sound. Especially the possibility to treat sound material out-of-time became essential for composition in the middle of our century: the possibility to record sound on magnetic tape and thus freeze its temporality offers new possibilities of operation on sound. Their impact on music creation may in a long run be comparable to the one music notation had on the development of occidental composition. The technological representations of sound26 suggest manipulations that are almost unthinkable with sounding sound, i.e. with sound in-time, the only way sound was directly accessible in the past. Like musical notation allowed for new compositional procedures through its representational capacities, the storage of sound on magnetic tape or in the computer changed fundamentally the way composers may think about sound.

In addition, the technological representations of sound (as electric current in the analogue music production studio or numeric information in the computer) allow for the synthesis of entirely new sound material with virtually no limitations and they permit the transformation of existing recorded sound. Various sound synthesis and transformation methods have been developed in the past four decades and are used in musical composition today. Sound synthesis means for the composer the possibility to compose the sound material itself and to implant on the level of the material properties that can be exploited on higher levels of musical organisation. The compositional process may thus be extended to cover the construction of the sound material itself. Another important aspect technology offers to composers today is related to the symbolic representation and calculation capacity of information technology. Computer systems allow the composer to represent and manipulate musical objects and simulate compositional procedures. Tools for computer aided composition are available to composers since about two decades and range from special purpose problem solving engines to general purpose music representations and simulation systems. Recent development in sound synthesis control and computer aided composition showed the need to closely integrate the two domains: the control over sound material and the modelling of structural and formal aspects of music. In general we can say that computers

allow composers to design models of sound and form. These models have an explicative and generative function27: They are used to represent and manipulate musical concepts as well as to produce musical objects (e.g. chords, sounds, rhythms) which can then be directly evaluated in the context of the concrete compositional project.

5.2 The Integration of Technology in Contemporary Composition

The creative potential offered by new technology matches well with the compositional requirements which have been expressed by composers in the twentieth century: the transgression of the mechanical and acoustical limitations introduced by traditional instruments and playing techniques, generally a better compositional control over timbre, the possibility to operate with a synthetic sound material whose aura does not directly relate to known sound sources, the interest of exploring the regions of ambiguity between harmonic organisation and timbre by directly controlling perceptually relevant aspects of sound, the integration of traditionally under-represented expressive means in music like the compositional control of space in the musical discourse - these are only a few examples of needs expressed by composers to which technology theoretically can respond to today. When looked at in a larger historical context these and similar demands appear coherent with the general development of western musical composition towards an absolute control of the final result. Inventions like the metronome, which allows to precisely specify the tempo of the interpretation, or the refinement of musical notation to describe dynamics and playing modes can be interpreted in that sense. It is not an accident that the first systematic use of technology in composition - in the elektronische Musik as it appeared in the middle our century - coincides with the climax of structuralistic orientation in composition: serielle Musik. Technology appeared to be the perfect means to realise the paradigms of serielle composition, which sought for total control over all musical parameters.

In that context it may seem paradoxical that only a few of the aforementioned technological possibilities are really accessible in practice. There is a substantial lack of tools which permit a compositionally adequate exploitation of the new possibilities. We can identify several reasons which contribute to this situation. 1) Most of the existing tools are developed for commercial music production and thus are based on implicit assumptions of musical expression which usually are not valid in the domain of contemporary music. There is a substantially larger market for tools adapted to commercial music than for any other branch of music. Development efforts for artistically more interesting tools are limited to non-profit research centres and private persons, such as composers themselves. The majority of technological tools for music production are thus developed under a commercial and technological perspective rather than an artistic one.

2) There are only very few tools which are well adapted to the compositional process. The central aspects of creative work, such as imagination, experimentation, exploration, evaluation, and organisation are not sufficiently respected in the design of computer tools. The results are inadequate user-interfaces and arbitrary technical limitations introduced by software developers with insufficient musical competence. Most aspects typical for the complexity of human expression and perception, such as the relevance of our body in exploring and interpreting the world, are under-represented in a mostly technologically oriented milieu.

3) The complexity of technologically mediated music production usually necessitates team-work of technicians and composers because the latter are rarely sufficiently skilled in order to use technological tools appropriately. This collaboration is very frequently the source of conflicts resulting from technicians' and composers' divergent ways of approaching problems of all kinds. Such conflicts lead to misconceptions. Hence aesthetic concepts are very often replaced by technological effects because artists are overwhelmed by the technological possibilities. Looking at the use of computers in the composition process from a more general point of view, we gain the impression that even composers themselves adopt a more and more technological attitude: The possibility of controlling and making available almost all musical parameters seems to overwhelm all other aspects of creative use of technology. This way of using computer systems seem to mark the end point of a long tradition, during which the composer aimed at becoming the sole controller and master of every musical event.

6. Resume

The example of computer use in contemporary music pointed out that the current employment of this technology is rather unsatisfactory. Instead of making creative use of the technological potential, computer art overtakes a technological habit of mind, which aims at control, domination, and the idea of making available all aspects of the world. As a consequence the individual forms of expression, which are traditionally attributed to art, are in danger to be lost. However, this way of dealing with technology is not immanent to the same: Rather is it the result of a long lasting tradition, which cannot be seen in isolation but that has its correspondences to intellectual and social attitudes. The metaphysical concentration on the subject appears as an essential element of explanation. The perceiving, knowing, and acting subject of mentalistic philosophy28 was not only at the centre of all questions concerning the meaning and the sense of the world but in its central role it also aimed at the total control over nature. For that purpose techniques and technologies were developed. They increasingly penetrated our life-world29, shaped the individual way of exploring the world and influenced its interpretation based on a technological attitude. As already mentioned above, the domain of art did not remain untouched by this development. Although up to present art could preserve residuals of an individual sphere as well as particularities in the manner of approaching the world. But a certain obsession with ingenuity30, as we can find it again and again in classical aesthetics, is deeply rooted in the metaphysical concentration on the subject, which may explain nowadays attitude towards technology. This is not only true with respect to the conception that the artist is the sole source and supporter of ideas, which have to be transmitted from a supposed inside to the outside, but it can also be seen in the general attitude towards the own product. When regarding in retrospect the tendency of composers to exhaustively prescribe and control all aspects of the musical process, we perceive an attitude similar to the technological habit of mind. It is exactly this kind of attribution by artists themselves or by others which results into an attitude towards technology which, by necessity, creates problems. Either the artist tries to realise his or her explicit idea by means of technological tools and often reaches so the limits of their own competence, of technology, or of the communication with technologists. Or the artists lets him- or herself seduce by what is technologically possible (e.g. by the possibility of total control over the sound material and the interpretation) to the extent that the artistic conceptions are compromised. The anticipated penetration of artistic creation by a technological habit of mind leads to a loss of the original potential of creativity which just results from an insufficiency of control and access. Art,

which was originally understood as the domain representing the particular, increasingly yields its place to a standardisation of all forms of human expression.

As a consequence, certain preconceptions need to be dropped in order to allow for a creative use of technology in art today. In that sense the concept of a solipsistic cogito as the only possible author of artistic ideas has to be unmasked as a metaphysical construct. It more and more has to be replaced by the conception that ideas develop in a context, in the togetherness of individuals, and in the process of exploring the available and accessible material. The artist should not any longer be regarded as the sole source of artistic ideas but may appear as a mediator in the attempt to articulate them aesthetically. This leads to a different approach towards technology and appears to be the prerequisite for its creative potential to become accessible. The technological possibilities should be explored in a playing manner in order to guarantee that they can be at all integrated into the artists' expressive repertoire. This way of employing technology may result into a richness of nuances and a diversity which is in clear opposition to the technological habit of mind ruling our present culture. Only based on such an approach, which leaves behind all ideas of control and domination, the use of techniques and technology may overcome a given state or existing structures and thus points to a dimension of freedom as it appeared in culture-critical analyses as the proper designation of art.

Acknowledgements

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1Italics by the present authors; reference: Iser, W., "Interpretationsperspektiven moderner Kunsttheorie", in: Henrich, D., and Iser, W., (eds.), "Theorien der Kunst", Frankfurt 1992.

2In German: Wahrheitsanspruch.

3In German: Erfahrbarkeit.

4In German: Erkenntnisinteresse

5In German: Geltungsanspruche

6We distinguish between "Realtechnik" = technology, which is charcterized by the production and use of technical products, and "technique as a process or procedure," which can describe all forms of goal-oriented activity. Here, we use the term in the sense of technology.

7In German: Erkundungsfunktion.

8See especially: Heidegger, M., "Sein und Zeit", but also Adorno, Th.W., "Aesthetische Theorie", Frankfurt.

9In German: Erkenntnisanspruch.

10Habermas, J, "Theorie des kommunikativen Handelns", Vol. 1 u. 2, Frankfurt 1981.

11In German: Autonomieanspruch.

12In German: Habitus. In the sense Bourdieu assigned to it in several contributions, e.g. Bourdieu, P., "Homo Academicus", Frankfurt 1987.

13In German: Gestaltung.

14Weibel, P., "Transformationen der Techno-Asthetik", in: Rotzer, F., "Digitaler Schein", Frankfurt : 1991, p. 224.

15In German: das Gegebene.

16Kant, I., "Kritik der Urteilskraft", Frankfurt 1984.

17Ibid., p. 228.

18 A danger which increases in information society.

19See as an impressive example: Piene, O., "Das Schone und das Tuchtige", in: Rotzer, F., "Digitaler Schein", Frankfurt 1991.

20See also: Zec, P., "Das Medienwerk. Aesthetische Produktion im Zeitalter der elektronischen Kommunikation", in: Rotzer, F., a.a.O.

21This has been explained by Benjamin, W., "Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit", Frankfurt.

22In German: handwerkliche Realitatsaneignung.

23In German: Realitatsvorstellungen.

24This response may consist in a mere adoption of current compositional techniques or in a critical evaluation, modification or transformation of the same.

25The Wagner-Tuba, which was built after the precise wished of Richard Wagner, may serve as an example here.

26For details on technological representations of sound please refer to Garnett, G. E., "Music, Signals, and Representations: A Survey", in: DePoli, G., Piccialli, A., Roads, C. (eds.), "Representations of musical signals", The MIT Press, London 1991.

27The notion of model which is relevant to our context is discussed extensively in Rodet, X. and Depalle, Ph., "De la voix aux instruments", Les Cahiers de l'IRCAM No. 2, Paris 1993 and in Assayag, G., "CAO: vers la partition potentielle", Les Cahiers de l'IRCAM No. 3, Paris 1993.

28In German: Bewu tseinsphilosophy.

29In German: Lebenswelt.

30In German: Geniekult.

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