Agostino Di Scipio

Later Arrivals.
Artistic Research in Music
and Music Technology Research

Abstract

This chapter addresses the scope and impact of *Artistic Research in Music* (ARM) as a field of scholarly concerns and – more importantly – as a cultural practice of our times. More particularly, it focusses on the scant weight academic ARM genealogies acknowledge to developments usually associated with *Music Technology Research* (MTR) but not in the least aligned with simplistic and pervasive technocratic views nor absorbed into engineering matters entirely. Often counted as marginal, such experimental MTR practices should be deemed instead as expressive of a more acute awareness and competent insight into the hyper-technologized environments in which music is made and listened to, in late-modern and contemporary societies. Their role in ARM genealogy and their relevance to actual artistic research work, today, should be more fairly considered. The chapter threads fruitful paradigm shifts and problematic aspects of ARM together with past and present issues in practice-based music technology research, particularly as emerging in experimental music currents and various forms of *sound art*. Case studies are finally picked up from recent and not-so-recent music history, providing examples of different artistic research attitudes. Overall, a confluence or convergence of ARM and MTR perspectives is called for, which might be positively rehearsed also in connection with efforts in current "science and technology studies" (STS), particularly in consideration of today's larger media ecology of live performance and other creative explorations of sound and music.

Key-words: Artistic research genealogies, practice-based research in music, sound and music technology research, inter- and cross-disciplinary research work, aesthetic and epistemic dimensions of creative music practice

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1. Introductory remarks

The field of Artistic Research is described as a "horizon of practices (…) situated beyond classical disciplinary partitions" [De Assis & D'Errico 2019: 1] and concerned with a broad and not at all homogeneous array of subject matters and research methodologies. Several definitions have been discussed [Doğantan-Dack 2015, Coessens *et al* 2019, Borgdorff 2007, Borgdorff 2012, Caruso 2022]. I will avoid providing one myself. Artistic Research "makes of the resistance to definitions, closures, and disciplinary constraints one of its strongest points" [De Assis & D'Errico 2019: 2], particularly in consideration of the epistemic complexity of highly elaborated semiotic objects such as artworks and artistic practices in general [De Assis 2014].

As a most fundamental feature of Artistic Research, I assume that the commonly distinct roles of 'artist' and 'researcher' are hold by one and the same person (or group of people): the research agent is an art practitioner and the research focus or object is her/his artistic practice. In work done by this new figure – the *artist-researcher* – "scholarly research and artistic activity become inextricably intertwined" [De Assis & D'Errico 2019: 3]. Personal creative labour is a valuable object of research to the extent that the research process provides findings of relevance to academic peers and the community of fellow practitioners. Tasks and methodologies adopted are inherently interdisciplinary, if not cross- or transdisciplinary. In this context, though, issues of interdisciplinarity may reveal special nuances and implications.

Practice is central, then, artistic as well as research practice. But crucial is their (necessary, possible, difficult) convergence. Committing oneself to Artistic Research is to acknowledge that there isn't too neat a separation between *praxis* and *theoria* in serious artistic endeavours. "Practices are arrays of human activity" [Schatzki 2001: 11], nexuses of activity materially mediated by a variety of technical and hybrid designs as well as by social conventions, cognitive constructs and physical constraints. Artistic practice is where the work of artist-researchers takes place, for the most time. According to [Doğantan-Dack 2015], and in agreement with the general 'practice turn' in contemporary theory [Schatzki 2001], Artistic Research has been connoted in many ways including 'practice-led research', 'practice-based research', 'artistic practice as research' and 'artistic research', a.o. One also finds 'research-based artistic practice' [Rutz 2023]. In French academic circles *recherche-création* is a rather common expression, recurrent through the decades but more particularly referred to research in or with music and sound technologies [Risset 1985, Veitl 1997, Palacio-Quintin 2014]. Overall, it's clear that many notions and definitions of Artistic Research exist (according to [D'Errico 2021], not all of them bear innovative insights for further scholarly or artistic work).

I take Artistic Research in Music (ARM) to mean approximately *practice-centred research in music and the sound arts*.[1] It happens when a musician or sound artist is actively involved in work meant to characterize forms of knowledge specific to artistic practice and bound to change and evolve with and through practice itself. The reason for the direct involvement of performers or composers or other practitioners in research is that they ask "the kinds of questions that would not naturally occur to the researcher" [Cook 2015: 60], questions born of personal involvement "but still questions that have a wider relevance than [personal] practice itself" [Coessens *et al.* 2019: 81]. Not so many musicians are of course interested in considering their practice as a kind of research or anyway as a knowledge producing task. Some would even object that music making has little or nothing of research; if properly developed, their arguments deserve careful consideration (an interesting example is [Croft 2007], where the notion that composition might be a kind of research work is firmly contested).

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[1] In this chapter I will make no clear-cut distinction between *musical* and *sound art* practices. This does not mean that there are no differences.

In this chapter, I'd like to address a few points concerning the scope and the impact of ARM as a field of scholarly concerns and – more importantly – as a cultural practice of our times. More particularly, I will consider the scant weight typical genealogies of ARM attribute to developments associated with Music Technology Research (MTR) and yet not aligned with simplistic and pervasive technocratic views nor entirely absorbed into engineering matters.[2] Often counted as marginal and relegated into the hideouts of artistic experimentalism, such developments are instead expression of a more acute awareness and competent insight of the hyper-technologized environment in which, *nolens volens*, music is practiced and listened to in late-modern and contemporary societies. Such developments may even represent instances of 'critical technical practice' [Impett 2021b]. I also keep in mind that various research agendas in embodied and enactive cognition [Leman 2008] and music creativity [Kaufman & Bear 2005, Leman 1999, Leman 2005] have been more often associated with MTR than with other research approaches.

I will first touch upon questions of general relevance for Artistic Research. In further sections I will try to thread them together with issues in practice-based music technology research. Finally, I will briefly discuss a few but important examples from recent and not-so-recent music history.

2. Between History and Academia

As this special issue of the RATM certifies, the debate on Artistic Research in Music is lively and diverse, even compelling. But, in some aspects, disheartening too. Compelling, in that it witnesses and fosters the acceptance and dissemination of a much necessary yet much belated shift in the epistemological and methodological orientations adopted in investigating musical matters: a shift from research work framed within "an unquestioned textualist paradigm" [Cook 2015: 14] towards a plurality of ethnomethodologically-informed, practice-centred accounts of the material, sensorial and cognitive-affective aspects of music making and listening. Disheartening, in that the emergence of ARM (and Artistic Research in general) is too often traced back to cultural dynamics that are both very recent and circumscribed within academic institutions. As a way to put it rather bluntly, it would seem that "artistic research is research conducted in an art institution" [Kirkkopelto 2015: 49]; and that "the possibility for artists to engage with research, and as researchers, has emerged recently through developments in Europe, North America and, increasingly, worldwide" [Coessens *et al.* 2019: 16] – where 'recently' translates "the past two decades" [Borgdorff *et al.* 2020: 1] or "since the (late) 1990s" [Cobussen 2019: 98, Caruso 2022: 19]. Other developments, earlier as well as coeval, are accordingly presented as interesting but occasional, disparate precedents and "signposts" [Coessens *et al.* 2019: 24] in a process finally configuring a more homogeneous area of scholarly inquiry. They would represent artistic research *avant la lettre* [D'Errico 2021]. At time of writing, "the perceived historical depth of Artistic Research (…) appears to be about twenty years" [Born 2021: 44].

Admittedly, the *post-hoc* construing of any new field of academic inquiry shows similar dynamics. In our case, however, too short and too narrow genealogies may be counterproductive for the scope and impact of the new field. In my view, the 'practice turn' in scholarly musical matters represents too important a shift for it to set aside a longer history of boundary-crossing experiences throughout at least a century of diverse cultural and artistic developments (often outside the academia). Along with such developments, so many practitioners – including composers and interpreters (if not also engineers and others non-musically trained) – have indeed

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[2] For the sake of clarity, in this chapter I prefer the wording 'Music Technology Research' (MTR) to the more common 'music research' (MR).

acted as researchers of some kind. Examples are innumerable. It's because the general conditions of music making and listening have profoundly changed (and keep changing) in their epistemic value beside their aesthetic scope that music has come to be grasped as a domain of experience in which certain bodily and intellectual skills get formed and transformed, along with various sensibilities and manners of being-in-the-world. It's because profound cultural changes have indeed happened that new research approaches turned out to be necessary to address the subtleties and complexities of music making and listening. ARM belongs to a 'practice turn' in artistic scholarship that emerged as a "response to a changed notion of art", following "a significant trend in contemporary art that focused on the production of knowledge rather than of artworks" [Busch 2009: 1]. "The hybrid phenomenon that we are now beginning to recognise as artistic-practice as research" [Gritten 2015: 88] emerged from an array of continuing hybridizations of artistic (and research) practices.

Disheartening is thus the apparent trading of developments in *music as research* for the academic accreditation of novel forms of scholarship that were born of the epistemic shifts brought forth in and by those very developments. To be clear, I am concerned not so much with academic genealogies *per se*, but more with their impact on the present and the future of musicking and listening as domains of experience involving knowledge dynamics that are widely recognized as unique within the larger social and cultural context. In some cases, it is candidly recognized that "it is not, after all, as if reflective practice did not exist until the final decades of the twentieth century. It is rather that practice as research reshapes it for the circumstances of today's knowledge economy" [Cook 2015: 21]. One may ponder the meaning of 'reflective practice' (see later in the chapter) but, more important, one may also add that different positions exist in the face of the larger scenario of today's economy of knowledge, including positions dissonant with respect to related politics of knowledge.

In any case, "why is (Artistic Research) generally de-historicised in its self-representation?" [Born 2021: 44]. Possible answers are likely to refer to the academic reframing of separate developments in artistic practice and research practices, and the contextual reworking of higher education agendas (started after the so-called Bologna Declaration, 1999). "The late arrival (…) of artistic practice as research" is described as "strongly related to institutional, cultural and national policies" [Doğantan-Dack 2015: 1], as an event *in* and *of* institutional policies implementing "the transformation of research infrastructures and of funded opportunities for the arts within the academic arena" [Coessens *et al.* 2019: 16] – with reference to still limited but expanding financial resources (praiseworthy, anyway) necessary to offer doctoral programmes for artists and musicians.

While it's not my aim to discuss institutional policies, I think that a very welcome side-effect of the current debate lays exactly in the possibility to discuss higher education policies *vis à vis* the strong determinism and the "bureaucratization of research culture" [Coessens *et al.* 2019: 24] paradoxically fostered in the scenario of neoliberal economy of knowledge.[3] I suggest that strictly intra-academic genealogies, albeit consistent with that broader scenario, are ultimately at odds with the openness and crossdisciplinarity typically claimed of and attributed to ARM. In my view, Artistic Research represented a 'late arrival' in the academia only in the sense that the latter was so slow in detecting and reframing novel research attitudes and orientations since

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[3] In the oft-cited 2015 revision of the Frascati Manual, the idea that artistic practice might be valued as research is *not* accepted because of a lack of adequate criteria for telling what in such domain of practice counts as research from what doesn't. Underlaying the discourse of the Frascati Manual, is a notion of 'research' explicitly traced back to the 'Research & Development' rationale of radically neoliberal economic principles and related politics of knowledge.

long evolving *in* and *along with* creative artistic developments. The question then becomes (again quoting Georgina Born), should "artistic research be understood as a kind of academicised, institutionalised and normalised prolongation or outgrowth of the genealogy of conceptual and post-conceptual art?" or other, coeval artistic developments [Born 2021: 48]? Is Artistic Research in Music an institutionalised and thus normalised outgrowth of multiple and not in the least homogeneous music practices – say, from 'historically informed performance' to experimental music and music-technology research?

I am interested in positions from which too narrow genealogies and disciplinary distinctions may be legitimately challenged, not necessarily to the detriment of the rigor expected of serious research work ('rigor' is not 'rigidity'). This view perhaps ties with other constructive critiques [Busch 2009, Born 2021] and with recent insights from fellow artist-researchers [Impett 2017, Impett & Cancino 2019, Impett 2021b, Gioti 2021, Manca 2021]. According to recent comprehensive overviews [Caruso 2022], today the main challenge of Artistic Research in Music is to find common academic guidelines for investigating musical practice and related creative processes. I hold that an equally if not more important challenge would be to embrace and make sense of the variety of meanings that doing research into creative practices might have. A huge wealth of creative practices, past and present, can represent for today's artist-researchers a chaotic background of fertile and even unsettling stimuli, an encompassing cultural and existential milieu. It should be ultimately seen more as a source of open-ended questions about the world and one's own place in it, than as a pool of case studies for scholarly work [Manca 2021, D'Errico 2021].

2.1 Aesthetic/Epistemic

The notion of 'art' held and conveyed in Artistic Research is endowed with a kind of epistemic dimension – not just aesthetic. In this context, the aesthetic and the sensorial are subsumed as modes of knowledge. Not only artistic research "acknowledges to practice particular aesthetic as well as epistemic value" [Schwab 2019: 27], it also investigates "how epistemic and aesthetic aspects of artistic making processes are interrelated" [Peters 2020: 125]. The production and the enjoyment of aesthetically rewarding artefacts or events (whatever the aesthetic criteria in play) would be less relevant in themselves, were they not to have semiotic and epistemic dimensions.

Science philosopher Karen Barad has noted that "performativity, properly construed, is not an invitation to turn everything (including material bodies) into words; on the contrary, performativity is precisely a contestation of the power granted to language (…) a contestation of the unexamined habits of mind that grant language and other forms of representation more power in determining our ontologies than they deserve" [Barad 2003: 802]. Knowledge about performance (or practice) is best developed *in* and *as* performance (or practice). No attempt at mapping or translating musical knowledge to another descriptive or phenomenological domain can retain intact the specificity and the plasticity of its sensorial and epistemic dynamics. The "primary mode of musical knowledge is musical" [Impett 2017: 226]. No verbalisation or sound recording or image tracking or sensor system (however valuable these can be to focus observation and gather data) can have us say what precisely is happening there – in sound, in action, in time, in space – that we call 'music'. More generally, art as addressed in Artistic Research is not "as yet another context in which to study the world through the application of scientific method" [Coessens *et al.* 2019: 82], it is rather experienced, conceptualised, and conveyed "as a different form of knowledge, a form of knowledge on its own" [Busch 2009: 1].

It is agreed that the kind of knowledge discussed here is not 'rational' or merely 'conceptual' but 'tacit', 'personal' and 'embodied' knowledge.[4] I myself agree, but I would also suggest that we may only speak of *musical* knowledge as knowledge-in-action that performs – in sound, time, and space; publicly or privately – the bringing together of several epistemic dimensions, not only bodily, sensorial and affective but also cognitive, relational and indeed technical. Artistry is by definition never without technicity. The question then becomes, how tacit and conceptual dimensions are interwoven and made to feed each another. Music making and listening always happen in a larger ecology of agencies through which the sensorial and the conceptual nurture, limit and construe each other [Di Scipio 1994]. As is manifest in peculiar performative contexts such as live electronic music performance and intermedia practices, musical knowledge is knowledge-in-action distributed among hybrid agential assemblages [Di Scipio 2020b, 2021], it belongs to the entanglement of "individuals and institutions, skills and techniques, modes of art and modes of enquiry" [Impett & Cancino 2019: 115]. It is certainly not knowledge as stockpiled information that we can look for, retrieve and apply as desired, but rather a dynamical and composite process productive of singular experiences and shared patterns of experience, the latter being disseminated, recontextualised and thus becoming in turn productive of further knowledge. Listeners themselves take part in that process. Listening can be more than 'active', it can be 'performative', it is itself a domain of practice [Voegeling 2010: xiii].

One may wonder whether ARM is the first scholarly approach addressing musical practice in terms of knowledge-level dynamics. Perhaps not... For example, consider efforts in 'cognitive musicology', started in the late 1970s and understood as a form of 'applied epistemology' [Laske 1977 and 1986]. The young Otto Laske had been a student with philosopher Adorno and with composer Gottfried M. Koenig, he perhaps couldn't resist overlapping the former's speculative and dialectic approach with the latter's more analytical and constructivist musical attitude. His cognitive musicology bordered with experimental psychology and later crossed with pioneering work in Artificial Intelligence [Balaban *et al.*, Tabor 1999, Schüler 1995]. His notion of the computer as an *alter ego* to the composer [Laske 1990] and the wider notion of (composer-written) software as a formal and incremental model of knowledge-level decisions concerning given tasks,[5] was indeed a form of *practice-based research in composition* of interest in the broader area of cognitive science. Cognitive musicology also included the modelling of listening tasks, as in the Observer computer program written in the 1970s by Laske with Barry Truax [Laske 1992]. Notwithstanding the support of Marvin Minsky and other AI pioneers [Balaban *et al.* 1992], such efforts did not raise enough academic recognition and did not result in long-lasting research programmes: it developed mostly in parallel with initiatives in computer music research and composition.

Work in cognitive musicology started of course under the aegis of the then-prevalent computational paradigm, where the human mind is seen an information processor (of sensory data) and the 'intelligence' being modelled is that of an expert problem-solver, of limited but highly specialised competences. As later developments turned to post-computational, 'connectionist' views, the research agenda of computational musicology was already lagging behind. In the 1990s and 2000s, neo-phenomenological paradigms emerged, typically pivoting around enactive cognition and embodiment studies [Godøy & Jorgensen 2001, Leman 2008, Reybrouk 2021], eventually siding with notions of aesthetic experience elaborated in the perspective of biosemiotics, neurophenomenology, and 'neuron-mirror theory' of sensory-motor perception [Cappuccio 2008]. While things have dramatically changed through such developments, Laske's "quest for an empirical

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[4] Notions of 'tacit' and 'personal knowledge' were first discussed in [Polany 1958 and Polany 1966].

[5] As in Xenakis's and Koenig's algorithmic music from the 1960s and even earlier work by Hiller and Barbaud in the 1950s.

theory of compositional knowledge" [1992: 61] appears in retrospect a far-reaching step relocating the observer's viewpoint (researcher) within the domain of the observed (composer, in the particular case).

2.2 Art/Science

Art involves "another kind of knowledge" [Cobussen 2007: 26] and seems able to grasp "that which cannot be articulated within [other fields of knowledge]" and that could be called – if not the uncanny – "the nonrepresentational" [Busch 2009: 4]. It makes perceivable the unknown as unknown and unknowable to other kinds of knowledge. But *that* turns out to be an important input to other forms of knowledge too.

Artistic Research is not 'research *for* art', that is, research aiming simply to "offer tools and insights for the benefit of the practice of art itself" ([Frayling 1993] as rephrased in [Coessens *et al.* 2019: 42]). That would ultimately iterate a deeply rooted separation of roles and functions, as in research work where "science and engineering are brought in apparently as subordinate disciplines to 'serve' what are assumed to be the pre-existing, autonomous creative 'visions' or 'needs' of composers and musicians" [Born 2021: 39]. That would be a kind of disciplinary dynamic described as a "subordination-service model of interdisciplinarity" [Barry and Born 2013: 10-12].[6] A more viable notion is perhaps 'research *through* art', where artistic practice is both the domain of the observer and the method of observation. In a different but related view, we may speak of 'art through research' or simply 'research art' – meaning that the two are not separately practiced, the one being practiced *as* the other, with no prior hierarchy intended. As noted above, the term *recherche-création* is kind of usual in today French academic jargon. In Italian one may speak of *musica di ricerca*. The wording 'research-based artistic practice' [Rutz 2023] is very rare but very significant in that it seems to imply not just a balance but an inversion of priorities.

Being focussed on 'another kind of knowledge', Artistic Research is to define its own binding criteria maybe "independent of (…) scientific methods" [Busch 2009: 4] but rigorous enough to be credible as serious and useful research work. Research methods and protocols are discussed in various publications (a.o. [Borgdorff 2012, Nelson 2013, Coessens *et al.* 2019, Caruso 2022]). Crucial – and indeed unsettling – is however the notion that research criteria are not defined prior to and independent of a direct personal involvement in the phenomena under scrutiny. That is clearly "at odds with one of the most fundamental tenets of research practice, the disengagement of the researcher from the object of his or her research [Coessens *et al.* 2019]. In Artistic Research "we acknowledge from the start that the research 'object' or 'issue' does not have a fixed identity" [Borgdorff 2012: 181]. The "interposed sensibilities of the researcher" are not just accepted or tolerated, they are legitimated "as validating the research rather than compromising it" [Coessens *et al.* 2019: 9]. The exchange between the artist-researcher's subjective instinct and cognitive rationale is understood as "both a valuable methodological tool and, potentially, something that can contribute to the output of the research process" [Cook 2015: 61]. "Artist-researchers – concludes Cook – must embrace that which makes them unique but attempt to understand and communicate it in terms that have more than personal validity" [Cook 2015: 56].

Equally crucial is the notion that research findings, and the contexts of their presentation and dissemination, are elaborated through a variety of media, often materializing in unusual assemblages and configurations.

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[6] In this sense the 'subordination-service' model of course applies to the mainstream prospects in Music Technology Research. However, it would also apply were roles swapped, i.e. when artworks and related productive activities are investigated to the benefit of scientific research.

The 'exposition of research' can take place in some kind of artistic performance situation, and the context of exposition or presentation "might itself be the topic of research" [Impett & Cancino 2019: 119].

Overall, the assumption that art is a knowledge domain of its own is a daring one: it says that science ultimately "is not the only place where knowledge is produced" [Busch 2009: 5]. It's a strong assumption, sounding as anathema to many. I subscribe to it. But I would also note that the Artistic Research discourse often risks conveying a somewhat abstract and simplistic notion of science practice. "The denominator 'scientific knowledge' is always already problematic" [Cobussen 2007: 21]. As a method of knowledge and a language for transmitting, sharing and incrementing its findings among peers in the scientific community, the work of science is itself practiced through a plurality of dynamics born of the wider historical and social context. It often capitalizes on intuitive knowledge, irrational choices and even random findings. One could recall, next to the historical dynamics of scientific paradigms (elucidated by Thomas Kuhn), interesting agendas in the epistemology of science developed in recent and not-so-recent decades (from Karl Popper to Paul Feyerabend and Imre Lakatos, from Edgard Morin to Andrew Pickering). It's not mere epistemological relativism to say that scientific assumptions and criteria (rationality, objectivity, falsifiability, verification protocols, etc.) vary in time, not always in logical, consequential ways. They "have been subjected to heavy criticism from many different sources" [Cobussen 2007: 29], since long including feminist perspectives and gender studies [Haraway 1991, Plant 1997].

2.3 In between and looped back

Introducing artistic practice in research institutions and doctoral curricula inevitably results into "uneasy tensions" and "conflicts" of academic dynamics [Borgdorff 2012]. One may wonder if the academic world realizes "what it will elicit by (re)installing specific kinds of artistic production within its privileged and well-preserved domain" [Cobussen 2007: 18], if they grasp the "subversive potential" [Impett 2017: 236] of forms of embodied knowledge-in-action such as musical knowledge. In this regard, one can assume that short-lived intra-academic genealogies of Artistic Research are strategically convenient to mitigate and smooth out the discrepancies born of the acceptance of artistic practice in academic research work.

Tensed relationships also originate from the peculiar interdisciplinary status of Artistic Research. Of special relevance, on this issue, is the case of *interdisciplinarity in one person*, a model of interdisciplinary work emerged since the 1980s [Barry & Born 2013]. While it is typically traced back to "the increasing availability and affordability of laptop computers and related software applications" [Born 2021: 40], I think of it instead as indicative of attitudes independent of specific technical or operative conditions, and quite frequent in practice-centred research in general. Also, the work of so many artists is innerved by heterogeneous competences and concerns.[7] On the one hand, it's typical of such artists to transcend received patterns in the division of labour and to fight disciplinary boundaries. On the other, this is a kind of cultural dynamic

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[7] The history of music abounds of course with composers active as performers (instrumentalists, singers, conductors) and performers active as composers. Remember, for example, the name of Muzio Clementi (who lived between the 18th and 19th centuries), pianist, composer, music publisher and piano maker. But today we should also consider musicians active as scholars or typists or studio producers or software developers, not to mention engineers active as composer or performing artists, artists as curators or managers, curators as art-theorists, etc. Remember David Tudor (pianist, composer, bandoneon expert, but also designer of electronic circuits and idiosyncratic electroacoustic systems). Or Glenn Gould (pianist, proto-researcher in music performance studies, writer, composer, and documentarist). In [Coessens *et al.* 2019], both Tudor and Gould are discussed as historical precedents to Artistic Research. Later in this paper I'll touch briefly on the work of a veritable polymath, Iannis Xenakis.

often found in artistic experimentation, as working tools and artistic sensibilities become each other's input and output.

To a large extent, art is made by also making – or at least thinking through and reworking – the tools of its making [Di Scipio 1998]. In that sense, artistic practice is an autopoietic process. On the other hand, very little of an artist's work can be entirely attributed to her/his individual skills, however gifted or ingenious s/he can be. No artist can claim complete productive and aesthetic autonomy: artworks and performance practices materialize *in*, *through* and *as* larger networks or assemblages, and creative behaviours always imply the cooperation or coordination of a variety of agents or agencies distributed across the practitioner's working environment, not entirely ascribable to her/himself. In their heterogeneous materiality, artistic practices are always collectively produced [Negri 2014]. An important feature of creative musicianship lies precisely in an ability to cope and live with that heterogeneity (we'll come back to this point later, while discussing related topics). A dialectic of autonomy and heterogeneity in productive labour (beside or beyond artistic language) takes place in genuine creative work [Di Scipio 1998].

An artist-researcher's interdisciplinarity and self-reflexive attitude are constituted in a feedback loop between the position of an observer (researcher) and that of the observed (musician). In the loop, interferences are likely to happen, including anomalous behaviours and dead ends (a risk systemic to all auto-reflexive patterns). It would be wrong, I believe, to equate 'self-reflexivity' with 'introspection'. The loop is not just *within* the artist-subject, it goes instead from the subject through the materiality of practice back to the subject. It feeds back through the environment where practice takes place. A situated and self-observing system is thus formed, potentially endowed indeed with autopoietic dynamics (autopoiesis always includes the environment as the self's necessary otherness). In my view, this intricate loop of human and non-human agencies defines the constitutively hybrid agential unit of artistic research: ARM practitioners are complex assemblages…

Although peculiar and problematic in the face of other research criteria, the artist-researcher's position seems to own much of an ethnomethodological perspective, as in research work described in fact in anthropology as *observation participante* [Descola & Ingold 2014]. Or perhaps, more aptly in our case, as *participation observante* [Di Scipio 2020a, after Ingold 2011].

The peculiarity of this epistemological position is perhaps most evident when an artist-researcher presents her/his work in public events, as in fact her/his responsibility in front of attendees is doubled (or halved, if you prefer): "the requirements of audiences (through aesthetic experience) and research communities (through the generation and reliable transmission of new knowledge) are rarely identical, and may even be in conflict" [Cook 2015: 59]. Different expectations overlap and add up, perceived by some perhaps as dissonant or contrasting among them. That is another source of possible anxiety or tension, albeit varying with personal inclinations and the particular media chosen for exposing/presenting the research findings.

2.4 Tensions, maybe not be mitigated

In academic contexts, a certain unease with Artistic Research resonates maybe from a more fundamental "clash between irreconcilable worldviews" [Cook 2015: 56]. Artists are after unique experiences, occasioned in specific and non-repeatable moments. What is really engendered in their work is never 'hard facts' that one can measure and quantify. Researchers are instead after matters of fact, their task is productive of knowledge to the extent that working methods, findings and 'end-products' can be precisely documented,

repeated, and shared as 'givens' (as *data*, in fact). At the best of their faculties, artists add something to the world, bring something in which was not there before and which may possibly induce changes in the world – however rarely and indirectly that might happen. The attitude of researchers (including of course researchers sincerely committed to change the world for the better) is instead methodical about fixating or objectifying (a small slice of) the extant world, at least temporarily and tentatively. In their experiments, they construe and fix experimental setups, they circumscribe the conditions of observation and experience in order to address a stable and precisely replicable bit of reality. Scientific knowledge and research are incremental, they 'advance', 'move further and 'make progresses'. Notions of 'progress' are always problematic; and they have no place in art making, independent of how refined and efficient apparatuses of production and consumption can be made.

When the two kinds of ethos overlap in one and the same person (or group), contrasting dynamics are bound to take place. Félix Guattari would have addressed such subjective (or intersubjective) situations in terms of *schizoanalysis*. Although varying with personal inclinations and backgrounds, a schizoid condition is structural to the figure of the artist-researcher. It can be more aptly characterized as "the dual situatedness of the artist-researcher (as both participant in their artistic activity and observer of it)" [Cook 2015: 56]. The artist-researcher engages not so much in a continuing, introspective 'dialogue' with her/himself, but more in the building of bridges between the artistic and other scientific or social discourses s/he embraces. The statics of bridges is always bound to a structural tension between the bridge ends.

In recent history, challenging developments in art and music have never been without some overt or covert criticism on established cultural institutions and their politics. Nor have they developed without close contacts with alternative circles and maverick social projects. Not so rarely, *music as research* has created its own institutional configurations.[8] One may ask, what in current Artistic Research (in Music) remains of those earlier cultural-institutional dialectics? What can or should be preserved of the contrasts inherent to those divergent politics of knowledge? I my view, what should be preserved and further elaborated is precisely the contrasts and tensions pervading everything from single instances of (undisciplined) music practice to large-scale institutional frameworks for (interdisciplinary) music research. A crucial epistemological novelty in the academic world would consist in the possibility to work out contrasts and contradictions born of divergent views in ways helping to preserve and 'compose' them, not turning them into conflicts (as composer Herbert Brün would have said).

Tensions endure typically in the face of unanswered (or unanswerable) questions. As is often repeated, raising questions is for artists more important than answering them. John Cage and other experimental musicians (as well as a number of surrealist and dada artists, before him) turned that into highly fruitful strategies. For the artist-researcher, the ability to "stay with the research question" [D'Errico 2021] is perhaps more crucial than the ability to come up with precisely defined research questions, and undermines the confidence that the research will lead to satisfactory answers.

At its best, Artistic Research could be a cultural practice that nurtures and disseminates an awareness that 'staying with the questions' and 'preserving the contradictions' *are* ways to respond to the complexity of musical practice and creative art making.

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[8] 'Historically informed performance' and 'electronic and computer music' are two areas where newly established institutions and specific organizational patterns have important roles.

3. Questions concerning (music) technology

For longer than a half-century, "the field of music technology has inherently lent itself to artistic research" [Impett & Cancino 2019: 126] through collaborative and multidisciplinary or interdisciplinary work that embodies changes in the dynamics of culture, academia, science and technology. Questions of music-technological research (MTR) and related developments in electroacoustic music and the sound arts have not been absent in ARM, albeit perhaps more frequently as introductory overview papers and book chapters than as actual research projects (with notable exceptions).[9] Even authors not personally working in MTR admit that "in the electroacoustic medium, practice and research are thus implicated within each other" [Doğantan-Dack 2015: 6]. More particularly, today there is growing interest in a joint reflection of artist-researchers, philosophers and scientists on the hybrid assemblages representing the technical environment of creative practice and the experimental setup of research work [Schwab 2018, Impett 2021b].

If the opportunity – or the necessity – to engage more fruitful connections has been rarely taken up, that's certainly because of the strong emphasis on engineering matters in MTR projects and policies, because of the unfortunate technocratic tilt of related discourses and a certain acquiescence to market-driven innovations in Information Technology. Also, MTR rarely shares the self-observing attitude required of Artistic Research. In MTR, artist and researcher are seldomly one and the same person – and if they are, findings are seldomly understood as having more than personal relevance. Strictly technical developments, on the other hand, are way too easily presumed to be of possibly larger interest. Finally, the history of MTR has roots in the early and central decades of the 20th century, siding often with new compositional endeavours and related aesthetic hypothesis: is that too far back in time and too narrow in scope to be of pertinence to Artistic Research?

That said, the real crux is perhaps one concerning different notions of what sound and music technologies are, may or should be about. Too often Artistic Research seems to rely on "a received notion of [technology as media of] reproduction" [Impett & Cancino 2019: 120], which is entirely at odds with so much creative work in music and sound technologies: actual instances of electronic and experimental music (live or not) "may have little sonic identity between instantiations" [*ibid.*]. In performative contexts and sound installation art, the notion itself of (mediatized) liveness is reworked and reconceptualised in several ways, and even instigates new ideas of *aura* and *atmosphere* [Di Scipio 2020a]. In many relevant artistic explorations, the older paradigm of the 'work of art in the age of its mechanical reproduction' (as in Walter Benjamin) appears since long outdated or in need of being profoundly reworked – yet that seems so hard to acknowledge, due to the dominant ideologies of commercial media.

If ARM is to open up "new avenues for artistic production through artistic research (…) for other modes of making art and, ultimately, another possible world to live in" [de Assis & D'Errico 2019: 2]; if "the artistic turn (…) implies a profound questioning of the place of the artist and his or her practice in contemporary society" [Coessens *et al.* 2019: 15] then, how could it cut short of MTR? A stronger integration – although itself counting perhaps as another 'later arrival' – is in the interest both of ARM scholarship and of practitioners addressing recent music and sound technologies. Much is to be gleaned from the history of music-technology research that might be an input to the current discourse on Artistic Research [Born 2021].

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[9] Among the exceptions, I would count the various research projects in which I have been personally and happily involved, developed at KUG-Graz, EDESTA-Paris8, ICST-Zurich, and elsewhere

In a later section I consider specific instances of MTR and related creative musical efforts, matching them against some strong points in the Artistic Research approach.

3.1 *In medias res*

Not only "artistic practice is a significant and essential component of many research projects in music technology (…) of any time" [Impett & Cancino 2019: 113] but – and more to the point – it always reflects "the modes of production within which it takes place and of which it is an instance" [Impett 2017: 228]. It would be a *faux pas* to pay little attention to the cluster of technical mediations involved in creative work and taking part in the array of knowledge-level processes and patterns of behaviour constitutive of practice. Technical objects and larger assemblages of heterogeneous but interdependent (not just 'networked') systems represent cultural agents shaping the material conditions of music making and listening.

We are thus taken back to the general issue of 'practice'. The social constitution of any practice comes inevitably with a specific *techne*, i.e. tools, technical specifics, and related technological principles. An artist's practice always embodies a peculiar relationship to technology independent of the latter-day devices involved. The meaning of her/his efforts is sublimated in the finished artwork or other 'end products', but is more tangibly captured and expressed in the specially devised performative patterns and settings involved in the process of making [Di Scipio 1995 and 1998]. Artistic practices are *epistemic practices* in that "(they) assemble materials, tacit knowledge, bodies, and aesthetic judgments in experimental setups" [Burri 2021: 181]. Karin Knorr Cetina [2001] calls 'epistemic' practice that is "based upon a form of relationship [which] by the nature of its dynamic transforms itself and the entities formed by the relationship". This is not practice as "the embodied acquisition of preferences, perceptual schemes and dispositions [or as] packaged routine procedures", but as "a relational dynamics that extends itself into the future in creative and also in disruptive ways" [Knorr-Cetina 2001: 196].

Art practices materialize individual performative/productive setups as hybrid and multi-layered assemblages – including mechanical, analogue, digital, telematic resources (or any subset of these). They of course include culture-specific social conventions, especially because the latter contribute to define the actual shape and the very materiality (architectural design, room acoustics, light conditions, various appliances) of spaces where art is performed or anyway presented. The ways performers and practitioners situate themselves in space, the ways their action relates to the shared space, is nothing marginal in the actual happening of a performance, and can be itself a medium for creative exploration (as it often happens, say, in Alvin Lucier's music and more recent creative trends [Di Scipio 2003, Waters 2007 and 2011]). Various sensibilities – amounting to smaller or greater degrees of interdisciplinarity – are involved in designing, crafting, or availing of the performance setting, elaborated individually or in collective work, in intuitive manners or in well-studied, expert manners.

Accordingly, the observation that "art practice as research always begins *in medias res*" [Gritten 2015: 80] seems never as appropriate as referred to MTR work, which is in fact typically situated at the crossroad of "multiple musical, discursive, and economic networks" [Impett 2017: 225] and involves greatly interdisciplinary competences.[10] Each particular productive or performative infrastructure represents a

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[10] Let's recall the subtitle of Pierre Schaeffer's seminal 'treatise of musical objects': *essai interdiscipline* [Schaeffer 1966]. In the person of Schaeffer (radio engineer, composer, music-theorist, media theorist, polemist…) 'interdisciplinarity in one person' was already at one of its peaks. The same goes for many pioneers of electroacoustic

special instance of the overly-technologized environment we all inhabit, in our daily matters, mirroring somehow the 'technological condition' of our times [Horl 2015, Horl & Burton 2017] – also described as the 'posthuman condition' [Braidotti & Bignall 2019, Braidotti 2022]. With the historical event of the *devenir-milieu* of technology – described and demystified in innumerable perspectives of contemporary theory (since at least Martin Heidegger and coeval philosophers, anthropologists and media theorists) – we understand 'technique' no longer as mere tool, instrument or prosthesis, but a new kind of Umwelt humans have come to set to themselves (and to non-humans, too…). When the place we dwell in (our *oikos*) is an environment thoroughly predicated upon multi-layered technical infrastructures, ecology and technology overlap between them.[11] The implications for the domain of creative musical practices are challenging – primarily (but not exclusively) for performative practices. Peculiar phenomena of embodiment take place within such hybrid environments [Clarke & Hansen 2009], including embodiment dynamics of interest to studies in musicianship [Lesaffre *et al.* 2013].

However, thanks to their being situated in the midst of hybrid technical environments, performing artists and musicians stand in a valuable position from which they can engage peculiar forms of *critical technical practice* – meaning practice "within which (…) reflection on language and history, ideas and institutions, is part and parcel of technical work itself" [Agre 2002: 131, Agre 1997, Impett 2021a]. Over the decades and up to the present day, a sizable but obscure territory of experimentation has grown where creative musicians and sound art practitioners can constructively problematize the basic tenets and the social dynamics of technoscientific research. Some years back, similar artistic dynamics have been discussed in terms of *subversive rationalization*, with the jargon of the 'critical theory of technology [Feenberg 1991, Di Scipio 1998, Kirkpatrick 2020].

Research work is itself always negotiated upon available or newly designed technical equipment, regardless of the historical frame particular to the object of study. Just like it has happened to artists across the decades, artistic researchers work within overly technologized environments and specially devised assemblages (not only 'laboratories' but concert halls, galleries, recording studios, public spaces, video conferences, and what else). Every research setup is an instance or segment of larger technical infrastructures. Artistic Research, as a cultural practice claiming its role in the academic scenario, cannot refrain from considering its work environment as relevant issue itself worth of being investigated. Of itself, that seems another good reason for it to pay special attention to creative work developed in conjunction with or at the margins of MTR.

These questions acquire further relevance when considering the direct connection of Artistic Research to higher education institutions and programmes. Shouldn't young Artistic Research practitioners be given a chance to better know and creatively explore the technical and communicative infrastructures involved in their work? Shouldn't they learn to appropriate and constructively cope with knowledge which is in fact not 'merely technical' and indeed materializes a variety of cultural agencies (including most pervasive and hegemonic ones)? Aren't they expected, as researchers and artists (and responsible citizens) to mind the larger array of mediators involved in experiencing music, and thus negotiating modes of knowledge described as musical?

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and experimental music. According to [Veitl 1997: 23], *recherche musicale* is a neologism introduced by Schaeffer himself, and implies a "…nouvelle pratique culturelle qui bascule les catégories établies" [Veitl 1997: 24].

[11] Today we customarily speak of media ecology, digital ecosystems, and – in circumstances closer to our debate – 'performance ecology', 'performance ecosystems' and the likes. The abuse of such terminology could be criticized (as would do Richard Stallman, computer scientist, activist and hacktivist). However, this terminology helps us stress the relational and connective elements, the coupling or co-dependency (more than 'interaction') among component parts of complex assemblages.

4. Artistic Research as in Music Technology Research

The word 'research' recurs in the names of earlier music technology facilities – just think of Friedrich Trautwein's and Paul Hindemith's Rundfunk Versuchstelle (the 'radiophonic research service' inaugurated around 1930 at the Berlin Academy of Music) or the better known Groupe de Recherche et Musique Concrete (GRMC) started by Pierre Schaeffer (in 1948, in the context of the French national radiophonic network).[12] A variety of labs emerged through the decades, in a variety of institutional sites – from very small, privately-funded workshops (e.g. the Systems Research Inc., established by the British cybernetician and artist Gordon Pask in the early 1950s, a research catalyst for his intermedia performance *Musicolour*) to larger institutions leaning on State-funded programmes (e.g. Institute de Recherche et Coordination Acoustique-Musique, IRCAM-Paris, since 1977). Not to mention facilities integral to university departments (e.g. Center for Computer Research in Music and Acoustics, CCRMA, Stanford University, since the mid-1970s).[13] Some of the latter were born of "an artistic impulse, a creative vision, and a political drive" [Impett & Cancino 2019: 124] based on late-modernistic views of art (and technology). In more recent times, they had to reinvent themselves to better catch up with other research communities, yet to a large extent they have kept (and keep) themselves to music-technology research agendas aligned with their initial cultural rationale.

I will now briefly comment on some examples of music research typically associated with the latter kind of institutions. I will turn then to individual musician-researchers whose work has been backed by smaller-scale organizations or has been carried out in rather informal, self-managed ways. In the work of the musicians mentioned below, *artistic activity and scholarly research are inextricably intertwined*, however under different research paradigms and in very different cultural and technical contexts. These are of course just some historical examples out of the many that could be included and further investigated.

4.1 'Coordinate'

I want to pick up the term *coordination* from the acronym IRCAM. In agreement with [Cont 2013], but maybe for different reasons, I find it more significant than it may appear and also helpful for discussing a variety of research institutions. Indeed, the model of interdisciplinarity typically implemented in such institutions can be traced back to the coordinate action of multiple agencies. One may prefer 'collaboration', of course, but the latter is perhaps too generic. In any case, we deal here with a recurrent trope in the discourse of early electroacoustic and computer music institutions. Already in the 1930s and 1940s, composers such as Edgard

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[12] In 1958 Schaeffer's studio was renamed GRM (Groupe de Recherches Musicales), as it is called even today after subsequent institutional reconfigurations.

[13] A large number of laboratories, including very recently started, have (or claim) the status of research institution. To list only those having the word 'research' in their names, one could mention – among others – ACROE (Association Création Recherche Outils d'Expression, Grenoble), Sonic Arts Research Centre (Queen's University, Belfast), GRAME (Groupe de Recherche en Acoustique et Musique Electroacoustique), CRM (Centro Ricerche Musicali, Rome), CIRMMT (Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie, Quebec), and so many others. Some of the European laboratories are or have been formally recognised as research units by the 'national research council' or other form of research network in their country (like France's CNRS or Italy's CNR).

Varèse and John Cage had strived (to no avail) to create facilities where musicians and technicians would work in close collaboration.[14]

In this institutional model, different agents (researchers, musicians, managers) provide different competences from separate fields of expertise. Implicit is a strict division of labour, in the context of which distinct competences are not expected to undergo significant transformations. To be sure, the latter is too crude a simplification of subtler and more complex dynamics … Anyway, the point is that this model is in fact "less interdisciplinary than multidisciplinary, for it is often based [as at IRCAM] on the institutionalisation, and therefore the prolongation, of a division of labour between composer or musician on one side and scientist or engineer on the other (…)" [Born 2021: 39].[15]

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The latter annotations are not at all to diminish the impact of coordinate MTR in important institutional contexts. Exemplary, in this regard, are pioneering contributions to computer music research by composers John Chowning (at CCRMA) and Jean-Claude Risset (at IRCAM Paris and LMA in Marseille). Their compositional work acted ultimately as a testbed for *and* as an input to a variety of investigations in digital sound synthesis, psychoacoustics, algorithmic composition a.o., in a continuing exchange bearing all evidence of a certain 'dual situatedness'. A comprehensive account of their research work would show a good balance between team work (with musicians and non-musicians) and personal expertise in segments of acoustics, psychoacoustics and computer science – beside their personal skills as composers (and instrumentalists) [Zattra 2007, Di Scipio 2017]. Their music research in the 1960s and 1970s resulted in a variety of end products, including tape music compositions, academic papers, acoustical models, software, institutions and – in the case of Chowning – patents and hardware apparatuses too.

The name of Canadian composer James Tenney is perhaps less known to ARM scholars. His early activity provides a vivid example of the earliest rapprochements between computer scientists and musicians. In 1961, having just graduated in Music-Theory and Composition, Tenney moved to Bell Labs to join Max Mathews and his team as they developed computer music and sound synthesis technologies (more particularly, the compiler program Music III). Tenney was formally recruited and payed for doing research in psychoacoustics,[16] but he also started a series of personal compositional projects [Tenney 1963] which provided Mathews with valuable input for developing his software. Features structural to Mathew's music and audio compilers resulted from the exchange. In that context, while addressing issues in auditory perception (grounding his later efforts in music-theory), Tenney also developed simple but effective generative models of algorithmic composition; that was strictly connected to his own compositional projects, of course, but eventually yielded in results of more than personal interest, circulated in the form of academic papers, textbooks, programming code scripts – beside scores and recordings, of course.

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[14] Teams with mixed technical and musical competences would later materialise in the context of electronic music laboratories, established in the 1950s in Paris, Cologne, Milan, and New York – as well as in many other sites around the world.

[15] To better grasp the complex dynamics of IRCAM (in its earlier years), one cannot but refer to the ethnographical work discussed in [Born 1995]. A coeval overview of the French computer-music institutions and related politics is provided by [Veitl 1997]. An introductory overview of the historical-institutional path of research at the CCRMA is in [Mody & Nelson 2013].

[16] Few years before, Milton Babbitt (of Princeton University) had been perhaps the first ever to claim that research funds should be granted to composers [Babbitt 1958].

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Surprising as it may be, for my next example I'd like to consider the British conductor, orchestra patron and audiophile Leopold Stokowski. From the early 1920s to the post-World War II period, Stokowski was also a keen observer of the early developments of phonographic techniques, including 'high fidelity' techniques and stereophony. Musically active in the US, in multiple occasions he offered his consulting services to Bell Laboratories, working with Harvey Fletcher and other acoustic engineers and physicists (later he did the same for the Philips research laboratories, in the Netherlands). As an exegete of the late romantic symphonic repertoire, Stokowski endorsed amplification and filtering techniques to achieve special tone qualities, in recording and concert situations as well. He aimed at somehow 'complementing' and even 'augmenting' the textures and colours of his orchestra. Musical critics often denigrated his overdoing and his highly rhetoric tones concerning these technical enhancements: as an interpreter of the musical repertoire, Stokowski was everything but philological… Yet he assumed he was only trying to materialize a musical potential that was in fact already there, in the sonorous power of the late-romantic orchestration techniques.

For the soundtrack of Walt Disney's animation movie *Fantasia* (1940), Stokowski was sided by RCA engineers in his attempt to make not a normal, direct recording of the orchestra performance but a tape montage of orchestral sonorities; he indulged in editing and altering the dynamics prescribed in a number of musical scores he had selected and directed (music from the classical, romantic, and late-romantic repertoire), and distributed the sound of the instrumental families over multiple loudspeakers. That marked the beginning of the Fantasound system, perhaps the earliest 'sound surround' diffusion system [Garity & Hawkins 1941]. In that context, the orchestra became like a rich source of sound to be further worked in the recording studio in order to achieve a 'greater-than-real' immersive effect. This was a notion of 'immersive sound' later taken up in more elaborate multi-channel sound technology, and anyway a recurrent trope in the history of modern music technologies worth of further investigations.[17]

In Stokowski's work, the practice of orchestral conducting has hybridized with new skills: the conductor now became the coordinator of various technical and musical assistants. He went as far as to try new ways to perform the classic-romantic opera repertoire adopting what we today might call 'live dubbing systems', hence anticipating later reworkings of the opera repertoire for the movie screen and the TV. This provides perhaps an early case of 'remediation' in modern music performance [Cecchi 2019].

Inappropriate as it might be to consider Stokowski's work as artistic research, it is clear that it addressed specific and reiterated questions (about the romantic orchestra sound, its bodily impact, its connection to compositional designs and the perception of musical form) with various and gradually more refined working methods, resulting in a variety of final research products (recordings, papers and books, new orchestral arrangement practices, etc.).

4.2 'Cooperative' and/or 'individual'

Looking for other kinds of convergence with Artistic Research, I would consider practice-based MTR work conducted in smaller scale institutional dynamics. It may be significant to pick the term *cooperation* from the

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[17] Beside some of the technical reports by Fletcher and his staff [Fletcher 1940] and by Stokowski himself [Stokowski 1932], introductory accounts are found in [McGinn 1983, O'Brien 2018, Tazelaar 2020, Ouzounian 2020]. More materials are available from https://stokowski.tripod.com/.

name of the Cooperative Studio for Electronic Music (CSEM), established by the young Gordon Mumma and Robert Ashley in Ann Arbour (Michigan) around 1955.[18] The choice is arbitrary, as in fact work done at CSEM between the 1950s and 1960s can hardly be described as research of any kind – safe maybe for some of Mumma's composing, performing and circuit making [Mumma 2015]. However, here I won't discuss Mumma's work in particular. Nor I will delve into the experimental music of Hugh Davies, David Tudor, David Berhman, Godfried-Willem Raes, Alvin Lucier, Walter Branchi, Mario Bertoncini, Michelangelo Lupone, Nicolas Collins, and many younger and much younger sound artists whose work raises questions of a kind non-practitioners wouldn't. I will rather use 'cooperative' or 'cooperation' as more generic terms conveying a definite yet informal notion of interdisciplinarity. Working *in cooperation*, people 'operate together', they conjointly manipulate things of interest to them. This is not like working *in coordination*, where people instead 'put things in order, together', things upon which they operate or can operate separately, things maybe not of their shared interest.

Next to cooperative approaches are approaches pursued by single, individual artist-researchers. That is kind of an abstraction, of course, as the work of individual artists and researchers can never be disconnected from that of colleagues and peers, let alone from technical and cultural agencies implicated in the media and the devices involved in their work. In actuality 'cooperative' and 'individual' research work can hardly develop along separate, non-overlapping lines, they rather shift one into the other (and sometimes shift into 'coordinate' work, too). Taken together, they do not stand necessarily in contrast to coordinative approaches, but do occur more frequently in smaller-scale institutions or self-managed organizational schemes leaning on the mutual assistance among peers. It's typical, in contexts of the latter kind, to call into question and transcend received patterns in the social division of labour.

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So many experiences associated with MTR can be traced back to cooperative and individual research contexts. Early electronic music instruments (in the 1920s and 1930s) and early analogue synthesizers (1950s and 1960s) emerged from the hybrid practice of individual 'inventors', usually musicians-engineers. So many names could be accordingly evoked, from Lev Thermen and Jorg Mäger to Oskar Sala and Hugh Lecaine, from Peter Zinovieff, Donald Buchla, and Robert Moog to less-known devotees to approaches of electronic *bricolage* (Paolo Ketoff, Martin Bartlett, Salvatore Martirano, Stanley Lunetta). Each manifested a peculiar blend of musical inclinations and technical expertise, each developed a unique attitude in the interpersonal relations with composers and musicians (and with funding patrons).

In the mid-1960s, the development of synthesizers was the outcome of various circumstances, including technological ones, of course, namely the availability of new electronic components (transistor technology replacing vacuum tubes) and related voltage-controlled circuitry. Voltage-control techniques, however, were not without roots in specific artistic developments. Consider, for example, the work of German composer Gottfried Michael Koenig. In the mid-1950s, Koenig entered the Studio for Electronic Music of the WDR, in Cologne, and soon started assisting Karlheinz Stockhausen and others. His skills in *studiotechnik* grew up quickly as he devised brilliant ways to manage the electronic equipment and have it fit to his own creative designs and those of fellow composers (including Franco Evangelisti, György Ligeti, Herbert Brün a.o.). In

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[18] As a facility, the CSEM was hardly more than service room within Milton Cohen's multifunctional Space Theater. The 'cooperation' consisted precisely in pooling personal skills and a few economic and technical resources (often self-built). Perhaps inspired by John Cage's Project of Music for Magnetic Tape (New York, 1952), such kind of self-organizational and self-managerial model would itself be of inspiration to many later initiatives.

that context, Koenig eventually figured out ways to avoid controlling the apparatus by hand (with knobs, faders, etc.) and to have it instead piloted or driven by selected pieces of the apparatus itself. With that emerged a form of *automated control*, later to be generalized through more refined voltage-controlled circuitry.

For Koenig, having a machine control another, was like 'analogue programming' (later it would be called 'sequencing'). He went farther in that direction in the 1960s, working at the Istituut voor Sonologie, in Utrecht. There, Koenig and Stan Tempelaars developed the Variable Function Generator, a kind of general-purpose voltage-controlled sequencer. In the meantime, Koenig had learnt some computer programming (at Bonn University) and had started writing his algorithmic composition software, Project One (PR1). The latter included both deterministic models (as in serial composition) and statistical models (pseudo-random number generation). Overall, that was an early attempt to model compositional strategies in the form of computer code. Revisions of the software represented refinements in the modelling of specific steps in compositional decision making. Others would later develop the approach and enlarge the rationale behind it (including Otto Laske, the initiator of 'cognitive musicology', as we have seen).

In the analogue electronic studio, Koenig's own composing provided him with insights useful for assisting other composers, while assisting others certainly provided him with new ideas for his own composing. As a computer programmer, Koenig acted as a composer minding his own creative tasks, while also writing software of possible use to others. One may say that his instrumental music (scores) and his tape music (including tape music scores, with special forms of notation) resulted from research work, and that his technical reports, academic papers, computer code scripts, and hardware apparatuses resulted from compositional work. Because Koenig was rather meticulous in documenting his investigations, later practitioners have been able to study his work not only by listening to recordings and playing music from scores, but also investigating the dynamics productive of those end results.

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Among the students Koenig met in the 1970s, in Utrecht, the young Barry Truax stands out for more than coincidental reasons. He studied Koenig's computer programs and developed himself algorithmic composition models, then later he married the latter with real-time sound synthesis algorithms of his own designs. That was a very demanding technical challenge (in the1980s). But it was also a crucial step towards a tighter integration of macro-level (musical) processes and micro-level (sonic) processes. Even more so in consideration of Truax's serious commitment to apparently very different matters, namely 'acoustic ecology'.

As a Canadian, in the context of Simon Fraser University (near Vancouver) Truax had met and studied with composer and environmental activist Raymond Murray Schafer, the initiator of 'acoustic ecology'. A very broad and compelling cultural agenda started in the late 1960s, acoustic ecology had a tremendous impact and helped increasing and disseminating a more acute auditory awareness of natural and urban environments. Beside fostering a number of new social practices (and the enactment of public regulations against noise pollution), work in acoustic ecology set the ground for situated sonic practices and 'soundscape composition' and also contributed to the later emergence of *sound studies* in the academic world. Truax himself would create outstanding instances of soundscape composition, beside publishing several academic papers and textbooks [Truax 1978 and 1984]. Having turned algorithmic composition tools into real-time granular synthesis and processing methods [Truax 1988], he was able to create significant bridges between two seemingly distant fields such as computer music and acoustic ecology.

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Speaking of sound synthesis, I'd like to draw attention on related peculiar efforts made by Iannis Xenakis for almost four decades. As early as 1959, Xenakis composed a tape music piece titled *Analogique B* (the production, completed at GRM in Paris, was started in Herman Scherchen's studio, in Gravesano, Switzerland). He did so by devising a primitive form of 'granular sound synthesis' with analogue means [Di Scipio 2009 and 2022a]. Coincidentally, that turned out to be the first time a musician has ever approached the electronic generation of sound in ways deliberately foreign to the most widely accepted scientific paradigm in the representation of sound, namely Fourier analysis. It was Xenakis' independent invention, indeed, but was obliquely connected with research work done fifteen years earlier by British-Hungarian engineer and information-theory pioneer Dennis Gabor [Gabor 1947, Di Scipio 2015].

Moreover, working on *Analogique B*, Xenakis addressed himself to a peculiar perceptual dimension of hearing, namely 'density' – or better 'temporal density', i.e. average number of discrete sound events in a given time unit. While the density and stratification of sonic units is known today to have perceptual relevance when hearing sound events of textural qualities [Bregman 1990], nonetheless no systematic psychoacoustic study has been devoted to it (the only exception is [MacKay 1984]). On this particular matter, Xenakis could deal with the density of his 'sound clouds' only in very empirical, intuitive ways (he invented a logarithmic scale of density values). In practice, he was tackling questions of auditory perception literally unknown to researchers in the field.

In the 1970s, with very basic computer resources, Xenakis elaborated various forms of 'stochastic sound synthesis' [Xenakis 1992, chapters IX, XIII and XIV]. This was an approach on sound entirely foreign not only to the Fourier analysis framework, but indeed to any reliable mathematical or engineering model of acoustic phenomena. Later in his life Xenakis refined the approach, writing new programs (whose code is available in [Xenakis 1992]) and composing two entirely computer-synthesized pieces, *Gendy3* (1991) and *S.709* (1994). These latter have more than something in common with the older *Analogique B*, although they sound radically different. Xenakis approached 'sound synthesis' as 'micro-composition', i.e. as a way to compose music down to the smallest detail (digital unit samples). 'Sound synthesis' was for him a medium apt to finally materialize 'stochastic music' as 'stochastic sound', with a variety of peculiar (and weird) timbral and textural constructions [Di Scipio 2009 and 2022a].

There's no question that Xenakis's work in sound synthesis, then, is an example of artistic research: it's research dealing with idiosyncratic and unique ways of creating sound and music, but resulting in findings of interest to other composers including computer music practitioners of younger generations [Hoffmann 2015]. The questions first raised with *Analogique B* concerned the corpuscular, quantum-like nature of sound, and its implications for the relationship between sound materials and musical form. Such questions re-emerge at several conjunctures in his life, in different guises and in different technological configurations. We may say, Xenakis stayed (his whole life) with those questions…

5. Other horizons of mixed practice

The prototypical example in genealogies of Artistic Research in Music is 'historically informed performance' (HIP), with its insights into "early (medieval, renaissance) music, through the baroque, classical and romantic repertories", today also extending to the early modernistic repertoires [Cook 2015: 14]. To be precise, though, we should only consider HIP research where the mechanics of older, 'original' instruments are investigated and reconstructed (as in pioneering work by Arnold Dolmetsch), beside approaches where of course

interpreters are themselves involved as researchers (which is not the case with *all* HIP).[19] *Mutatis mutandis*, a practice-based approach on historically informed performance also characterizes efforts meant to reconstruct and preserve the electromechanical instruments built and played by Hugh Davies in the 1960s and 1970s [Mooney 2013 and 2017] or to revive David Tudor's self-built electronics and ephemeral sound-processing devices [Kuivila 2004, Cameron & Rogalski 2006]. Efforts of the kind belong to a broader and compelling task, namely the preservation and revitalization of early electronic music and experimental intermedia or multimedia works, which indeed represents a very rich interdisciplinary artistic research domain where questions of technology, aesthetics, archiving, and performing overlap and intermingle in complex ways.[20] I deem such research domain integral to what our friends at the Orpheus Institute call "historically informed performance of experimental music" (HIPEX).[21]

It is anyway clear that a more inclusive notion of *music as research* would also take into account other agendas, past and recent (and present). I would include ethnographic explorations neighbouring with compositional designs (as in Bartók, Kodaly, Percy Grainger a.o.) as well as recent endeavours merging anthropology and sound art (e.g. Stephen Feld's 'anthropology in sound', or *acoustemology* [Feld 2012]). I would also include the domain of *extended playing techniques*, the investigation of a broad range of new or unconventional instrumental as well as vocal performance techniques, a domain too rarely addressed in scholarly insight yet rather persistent in recent music history.

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'Extended playing techniques' (EPT) is a loose definition for either novel or rare ways of playing instruments, more or less challenging and transformative of the instrument's 'natural' sound. A precise definition is perhaps impossible, we deal here with a hardly determinable range of playing practices subject to even vary with each performer (and with each instrument). EPTs are often understood as interesting but flimsy effects enriching the palette of more usual timbral possibilities. Sometimes they are instead elevated to the rank of musical materials suggestive of new creative designs (as, for examples, in Helmut Lachenmann's or Salvatore Sciarrino's chamber and orchestral music, as well as in the late Luigi Nono's works for instruments, voices and live electronics). They are frequently explored in improvisational contexts, too. Required of the performer is typically a more direct, physical involvement with the instrument's body, seen as a technical object built in specific (maybe expensive) materials, featuring ingenious mechanical designs, and of course imbued with significant historical-cultural connotations. The instrument of course represents a testimony of older traditions, and thus eventually invites more conceptual attitudes meant to comment upon and deconstruct its iconic cultural status.

As is well known, special bow-strokes, pizzicato sounds, and harmonics (*flageolets*) and other then-new manners of playing, were not too rare in music for string instruments from the first half of the 20th century. It suffices to recall certain passages by Berg, Webern, Bartók and many others (remember the eponymous 'Bartók pizzicato'). But a deeper interest for approaches going beyond usual performance techniques really

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[19] Not all HIP research is practice-centred and shares interests with 'performance studies', of course. When researchers condition performance choices to textualist hermeneutic musicological research, performance practice is not "a primary mode of signification in its own right" [Cook 2015: 14]. See also [Rink 2015].

[20] This is not the place to tackle this particular interdisciplinary topic and provide more substantial references. I only want to note that several related efforts emphasize a need for practice-based research [Bernardini & Vidolin 2005, Polfreman *et al.* 2006]. See also the *Performance Practice of Electroacoustic Music* database (http://ppeam.zhdk.ch/).

[21] For an introductory survey see (https://orpheusinstituut.be/en/projects/hipex). Efforts of the kind, but more focussed on electroacoustic music practices, are pursued today in Italy, too (e.g. at departments in the Conservatoires of Turin and L'Aquila, as well as at the L.E.A.P. independent laboratory in Rome).

boomed in the 1970s, at least in European musical contexts. At about that time, a number of composers and instrumentalists started researching more systematic ways to enlarge or extend their playing techniques, sometimes opening to extremely demanding forms of instrumental practice (themselves instances of 'critical technical practice', in a way).

Ever since then, more instrumentalists (and vocalists) have engaged in documenting similar efforts, describing details of the physical manipulation of the instrument's body and trying ways to notate – with varying degrees of precision – the resultant sound effects or the actions causing them. Internationally renowned cases include Bartolozzi's work on woodwind instruments [1967] and Rehfeldt's on the clarinet [1977], Robert Dick [1975] as well as Artaud and Geay on the flute [1980], Penazzi on the bassoon [1982] (the latter integrating Graziano Tisato's computer sound analyses, processed at Centro di Sonologia Computazionale di Padova). All such authors took much care in preparing fingering charts for the production of 'multiphonics' (polyphonic sounds emitted by monophonic instruments). More examples include work bearing on extended vocal techniques (EVT) [Szanto 1977], as well as on the violin [Borciani's 1977, Strange & Strange 2001], and several more recent efforts.

To be sure, not all EPTs can be captured in words or in graphic-symbolic notations. Because of inherent mechanical complications, documenting and circulating them is better done with audio and video media.[22] And yet, even audio and video can reveal far from satisfactory. The very bodily intimacy with the instrument makes it hard or impossible to map the bodily performance into a different media. The only way to really grasp what is being described is to actually embrace the instrument and try approximating the bodily conditions and the resultant sonorities that are the object itself of the research! In this context, it is necessary for the researcher to involve him/herself with the instrument.

In work by younger performers and composers, a focus on extended playing techniques often overlap with an increasing interest for 'augmented' instruments, i.e. musical instruments (or other appliances used as such) equipped with sensors and electronic prostheses managed by a computer, or equipped with self-built mechanical adjunctions. Examples of the latter kind range from the now classical 'prepared piano' (as in Cage) to self-built mechanical and electromechanical appliances (as in work by Mauricio Kagel or Mario Bertoncini), not to mention more recent proposals (in the work of Panayotis Kokoras, Andrea Valle and others).

Computer-augmented or mechanically-augmented instruments define an area of practice that brings us back to issues discussed in a previous section, concerning the hybrid environments of the contemporary 'technological condition', in general, and the 'posthuman' ecosystems of music performance practice, in particular. Augmented instruments can attract research on embodiment and distributed agency, greatly important in our time precisely because of the hyper-technological and multi-modal environments in and through which they take place. There is a need to better understand a kind of dual or bidirectional dynamic of embodied cognition: the internalization (and naturalization) of affordances and resistances present in the environment is always contrasted/complemented by the externalization or distribution of cognitive faculties in the environment [Di Scipio 2020a]. These topics may define a fertile territory of the convergence between ARM and MTR. In a broader view, the study of skill – including in playing instruments – demands today a wider ecological approach [Magnusson 2019: 171, after Ingold 2001].

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[22] Numerous internet sites today provide this sort of documentation and related information (not all reliable, in all honesty).

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I will conclude with a well-known example from the most remote history of modern instrumental techniques. I propose a quick look at the work of the American composer Henry Cowell, in the context of which the exploration of specific piano techniques and related musical materials was key to compositional efforts as well as to a broader music-theoretical vision. [23]

Some of Cowell's early music for piano makes abundant (if not exclusive) use of tone clusters (e.g. *Dynamic motion*, 1916). Other works are written for 'string piano', so they are performed by playing only or mainly the piano strings (*Aeolian Harp*, 1923; *The Banshee*, 1925). Based on the scrupulous observation of the harmonic possibilities of tone clusters, and matching them against the series of overtone frequencies, Cowell "developed a theory in which the systematic inter-relationship of notes was transferred to the field of tempo, rhythms and dynamics" [Kagel 1959: 41]. In sum, pitch relationships were mapped into metric relationships, establishing a theoretical and phenomenological equivalence between harmonic and rhythmic structures. This empirical approach informed already some of Cowell's chamber music from the mid-1910s (*Quartet Romantic* and *Quartet Euphometric*). Later Cowell pondered far-reaching implications of the particular approach, and discussed them in the book *New Musical Resources* [Cowell 1930]. That perhaps represents the first attempt to have the details of an unusual playing technique (tone clusters, with atonal harmonies) develop into a larger music-theoretical framework.

In the 1930s Cowell envisioned an experimental setup to develop his research, calling for help from Lev Termen (inventor of the Theremin). Based on the composer's design, the inventor built the *rhythmicon*, an opto-electric-mechanical device. It allowed the composer to translate notes and chords played on a small musical keyboard into discrete sound-pulse sequences (low frequency, in the sub-audio range). With it, Cowell could better investigate his 'rhythmic harmonies'. The rhythmicon is often discussed in the context of the proto-electronic musical instruments. However, safe for the *Concerto for rhythmicon and orchestra* (1931), Cowell did not use the rhythmicon as a performance instrument, as the very few prototypes built by Termen were in fact so fragile and hardly portable. The rhythmicon should be rather understood as an aid to the composer (as in expressions like 'computer-assisted' or 'computer-aided' composition). Cowell benefited from it as he composed music scored for usual instrumental resources (*Rhythmicana*, for piano, 1938).

Cowell's influence on John Cage and other experimental American composers is very well known. But his mapping of pitch intervals to metric relationships would resurface only later, especially after the 1958 reprint of his book. Beside the detailed discussion offered in [Kagel 1959], indirect but significant connections can be drawn with the music for pianola composed by Conlon Nancarrow in the 1940s, as well as with Stockhausen's notion of the 'unity of musical time', developed in the context of his serial and electronic music from the late 1950s (*Gruppen* for orchestra, 1956-57; *Kontakte* for percussion, piano, and tape, 1960).

It would be highly disputable to regard Cowell's as Artistic Research. Yet, we must admit he patiently addressed a nucleus of questions initially born of unusual piano techniques, and that he did so by speculative as well as experimental approaches. The 'end products' of his research include scores, electromechanical

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[23] Cowell (like his student, John Cage) was aware of the so-called 'tack piano' and other simple tricks to modify the piano sound, commonly used in his time. The 'tack piano' (very popular in north-American dance halls and saloons in the decades between 19th and 20th century), was just any upright piano with the hammer mechanics duly 'prepared' with extra materials providing the sound with a sharper attack and a brighter resonance.

devices, books, and they eventually inspired further work by other musicians and scholars. Recent authors made software models of the rhythmicon [Dixon 2009].[24]

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For Cowell, pitch intervals were of course 'equally tempered intervals' (belonging to the classical equal-temperament tuning system). Had he considered intervals smaller than the tempered semitone, he would have obtained very peculiar rhythmic patterns, slowly shifting in and out of phase – in fact, the equivalent of frequencies so close together as to create 'acoustical beats'. But that is what the young Steve Reich eventually did, in the mid-1960s, first with tape music techniques, then with a device known as the *phase shifting pulse gate* built in cooperation with engineer Larry Owens of Bell Labs. Reich produced very little music with that device (*Pulse music*, 1969), but experimenting with it helped him to envision the kind of minimalist music he would soon develop, largely based on phase-shifting rhythmic patterns.

6. More than a conclusion, future connections from a personal standpoint

Just as it is the interest of Artistic Research in Music to ask itself 'questions concerning technology', so it is the interest of today MTR practitioners and sound artists to join artistic research projects wary of the discourses implicated in technoscientific research. Closer connections can only be mutually beneficial. Is it too late?

Some thirty years ago I called for a higher ethnographical awareness in scholarly work on electroacoustic and computer music [Di Scipio 1995]. I argued that a deep reframing of musical experience and a substantial reworking of practice was taking place in creative musical approaches in that kind of musical context, and that an equivalent reworking of music-analysis was requested, a shift of focus from structural and formal features of the finished musical artefact to the actual process of producing it. In short, a 'practice turn' was needed to engage the 'genetic analysis' of creative music technological efforts. I was leaning on previous efforts (including Laske's 'composition theory' [1991]), but I was leaning primarily on personal experience in composition and music analysis.

Later, in parallel with my orientations as a composer and sound artist, I embraced practice-centred views of live electronic music performance and sound installation art, merging questions of situatedness and embodiment with a focus on hybrid multi-agent systems [Di Scipio 2003, 2008, 2022b]. The perspective ended up being captured in the notion of the *performance ecosystem* [Waters 2007 and 2011, Di Scipio 2020b and 2021], understood both as a relational, empirical framework for addressing issues of more-than-personal interest (embodiment, 'liveness', and new notions of agency and instrumentality in music and sound [Reybrouk 2006, Magnusson 2019]), and as an operative approach on performance with live electronics and hybrid infrastructures.

In many respects, the latter orientation resonates with convergences today taking place among different research agendas. It has been pointed out, for example, that "artistic research and sound studies have more in common than their shared emergence at the end of the twentieth century" [Cobussen 2019: 99]. Also, following the recent 'practice turn' in Science and Technology Studies (STS), it has been observed that "musical practices and their technologies have become a research subject in STS as well as in the related field of sound studies" [Borgdoff *et al.* 2020: 11]. The STS perspective is said to represent a useful framework for

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observing "the activities of artists and composers who *use* and *assemble* technologies as part of their creative practice" [Pigott 2020: 97, my emphasis], and for understanding them as peculiar "sites of encounter of human and nonhuman agency" [Pickering 2001: 174]. This kind of research work has for "the last twenty-five years or so (…) given way to analyses of the longer history of art and science as ways of categorizing knowledge", and has often involved hybrid practices "and a commensurate shift in (…) analytical and conceptual equipage" [Star Rodgers & Halpern 2020: 1]. In my view, there might be a meaningful confluence with questions concerning the techno-ecology of live performance and other approaches of relevance to Artistic Research (in Music, in Music Technology, and in media art in general).

If that confluence seems possible, it's because Artistic Research, Sound Studies and Science and Technology Studies after all share more than a few central themes, including subjectivity and relationality, sensoriality and materiality, boundary disciplinary practices, embodied and situated cognition, human and non-human agency. Their separate agendas have independently developed through repeated ramifications of cultural theory (several well-known 'turns', from the 'performative turn' to the 'practice turn' and the 'material turn'). They share an emphasis on "the constitutive role of material and social practices in the production of knowledge and technologies" [Borgdoff *et al.* 2020: 1]. From different directions, they concern themselves with today's larger media ecology of current art practices, hence with the *machine milieu* [Sanfilippo & Di Scipio 2019] in which and through which today creative labour nurtures and develops unique forms of knowledge and awareness.

The lack of closer connections cannot but limit the impact of ARM and, at the same time, increase the marginalization of (past and present) creative practices, in the face of the broader market-driven cultural dynamics. In that broader scenario, even the most genuine and valuable efforts in knowledge production are "in danger of being associated with knowledge manipulation, with unbridled commodification, with intellectual alienation, and with human subordination and regulation" [Coessens *et al.* 2019: 169]. If artistic researchers perceive the danger (as they hopefully do), it would be their interest to enlarge the scope of their research and connect with creative practices growing at the margins of Music Technology Research.