to collecting and keeping information updated for (re-)performances of musical works (cf. e.g. Lemouton/Goldszmidt 2016, hal-01944619). This is particularly relevant in so far as the information archived concerning a musical work can strongly influence its possible future appearance (cf. Akkermann 2019, http://doi.org/10.5281/zenodo.3484546).

The presented articles in this issue of array mirror discussions that have already been tackled at the ICMC panel sessions on "computer music heritage" 2018 in Daegu/KOR, hosted by Kevin Dahan, and "archiving" 2019 in New York/USA, hosted by TaeHong Park, involving also the other authors and the editor of this issue. The panels have shown that there is a broad interest in the community and a need for more discussion. In the following, some of the mentioned aspects are now connected to most recent reflections, considerations, projects and debates, providing a broad and substantial starting point for a future debate on archiving approaches and projects.

The electroacoustic repertoire: Is there a librarian ?

by Serge Lemouton

Introduction

Until proven otherwise, our civilization is still a civilization of the Book. Libraries are the places where books are transmitted over time. Works of plastic art, paintings, sculptures, are exhibited, preserved, restored in museums, with the specific difficulties posed by the materials and techniques used. Cinematographic works have their cinematheques, but seem more difficult to preserve when we realize that some films have already completely disappeared. We can consider a musical work as a text: musical works in the form of written, printed or handwritten scores also have their libraries. But what happens when music, since the advent of possibilities opened up by the means of technical reproduction, includes elements that are not strictly notated in form of text? We are interested here specifically in music of scholarly or experimental tradition (real-time electronic music) using new instruments such as synthesizers, samplers, effects, pre-re-

corded sounds, amplification devices and spatial sound diffusion as well as all kind of sound devices or computer music system.

Paradoxically, digital resources need more care to be preserved than information written on paper. The inherent fragility of digital materials leaves only a small window of time during which they can be preserved before being erased forever. The electro-acoustic music works considered therefore pose specific problems of transmission and diffusion; these problems, of various natures, are beginning to be recognized and studied. This repertoire has grown throughout the last century and is very important both in terms of the number of works and of interest in the history of musical art. And it became so important that these new instruments and digital means will infuse the vast majority of current musical creation in all directions. Within the framework of a recent working group, we were interested in the methods of "how" to preserve, and in the inscription and the dissemination of this repertoire, but not really in the question of "who" is preserving: who has the responsibility, the duty to ensure its conservation for future generations?

Who should assume this role? Is it the composer, the performer, the publisher, the musicologist, or the music historian? Is this responsibility collective or individual?

Composers

We can think that the first actor involved in the preservation of musical works should be the author. First of all because it seems obvious that composers from the Western tradition write music for the posterity. Secondly, because it seems that they are the first ones to have the moral duty to preserve their productions. In practice, however, we observe that this responsibility is rarely assumed by the composer.

Here we can question the notion of the work of art as artefacts built for the posterity. Is writing for future centuries historically situated, is it a notion born with romanticism? Music is an ephemeral art, but isn't the urge to leave a trace consubstantial with all artistic practice since the origins of humanity?

In the specific case of contemporary music, we observe a paradox: the composer notates the instrumental part more and more precisely, while

the electronic part (in general, however, so essential to the work that one cannot envisage to play the piece without) is not fixed (at least very rarely by the composer himself).

While some composers have been actively engaged in documenting, preserving and transmitting the electroacoustic part of their works, this is not generally the case. We can cite the case of Karlheinz Stockhausen, a composer characterized by an extreme control on his works, who himself produced a critical and complete edition of his scores. This edition is so exhaustively detailed that we can predict that its preservation is assured. But this case seems rather the exception in the context of contemporary music. What we learn from this particular case is also that we must not neglect the role of the artist's family in this question of preserving an artistic heritage.

One can wonder about the reasons for this fairly constant lack of interest among composers for the documentation of the electroacoustic part of their pieces. Is it because of a theoretical difficulty or a practical impossibility? Is it an educational problem? Is it due to the lack of theoretical means (it is well known that there is no standardized notation for electroacoustic devices which could play a similar role as traditional music theory does for the notation of instrumental music)? Is it simply for practical reasons (preserving software data requires an appropriate infrastructure)? It can also be due to a lack of knowledge on the developments of languages and computer systems — but who in this area can claim to master the complex issue of obsolescence and prophesy about the evolution of computing?

Why do composers not have the will to write the electronic part of their works? Do they consider that the electroacoustic part of their work is secondary, accessory, less noble than the instrumental part?

The electronic part can also be the result of a collaborative work, it is sometimes co-composed or co-produced by what is generally called a "computer music designer". It can also sometimes be entirely produced by the latter; in this case one may wonder whether it is really up to the composer to include it in the score.

The question of safeguarding this repertoire is all the more crucial today as the first generation of composers to use the means of expression

offered by computer music are slowly but inevitably disappearing. If they are the ones who should store their own computer archives, what is left after? Is it up to their possible heirs or beneficiaries to preserve their archives? We can cite Pierre Henry as a successful example, whose home studio and domestic sound library are saved for the future, finally supported by both the National Library of France (cf. https://www.bnf.fr/fr/toute-loeuvre-de-pierre-henry-la-bnf) and the Philharmonie de Paris (cf. https://philharmoniedeparis.fr/fr/musee-de-la-musique/collection/parcours#studio-pierre-henry, last access Sept. 14, 2020), thanks to the commitment of its beneficiaries. After the passing of Jean-Claude Risset, his archives were finally taken care of by a CNRS laboratory (cf. https://musinf.univ-st-etienne.fr/SiteRisset/archives.html, last access Sept. 14, 2020).

Computer Music Designers

Although there is some recent work on the position of computer music designer in electroacoustic music (Zattra 2016), the nature of their activity remains largely unknown. Indeed, their activity is not limited to the "design" of the computer part of the musical works in which they collaborate, but also encompasses (among others) interpretation, documentation, archiving, and updating the pieces from their personal repertoire.

The computer music designers are, by virtue of their activity as performers, experts in the question of the evolution of computer music environments. Their job and the rapid development of computer music tools require them to always be in "technology watch" mode. Indeed, among the many tasks implied by their position as *Réalisateur en Informatique Musicale* (or RIM, french for Computer Music Designers), porting (migration of the electroacoustic part of a musical work from one material system to another) due to a change of the computer environment, new software versions, operating system evolution (etc.) is probably the activity which occupies the most of their time and energy. Consequently, computer music designers have empirically developed knowhow, methodologies and systems to facilitate the porting of works in order to ensure their playability over time. Among these systems, we can cite the Sidney database

developed and hosted at IRCAM (Lemouton 2016), allowing the operational backup of documents created in the institute since its creation in 1977.

Nevertheless, the computer music designers' as well as the instrumentalists' knowledge on how to play a particular work and how it should sound, remain strongly oral and seems to be passed on from person to person. The preservation environment developed at IRCAM is also an attempt to make this knowledge explicit, to transmit and preserve it (through "performance notes", interpretation notes).

Even if the performers have an essential role to play in the transmission of works, preserving the piece for future generations seem not to be their responsibility, and neither is distribution.

Publishers

Traditionally, this role would fall more to music publishers. From the very beginning of musical printing in the Renaissance, publishers have assumed this role of commercialization of the scores and therefore of disseminating works. Unfortunately, during the 20th century, few music publishers realized the importance of the technological developments in musical practice. Historical publishing houses have not equipped themselves to respond to technological developments in the field of digital distribution of music online, and even less to the distribution of works involving hybrid or heterogeneous media. This means that when performers order scores of mixed works, they receive elements of the electroacoustic part, but rarely they receive usable material.

In short, if publishers have the mission of disseminating and preserving the works of composers in their catalog, it seems that they have not given themselves the technical means to do so.

Creation Centers

Many works from the 20th century electroacoustic repertoire have been produced in and/or commissioned by institutions (radio studios, laboratories, research institutes, creation centers, etc.). These institutions, at least some of them, may have the mission of preserving the works created on their behalf.

Institutions are not eternal and when they close their doors, their

archives can disappear. Among the important institutions of the 20th century music history that have disappeared, there are, for example, the studio of the Westdeutscher Rundfunk (WDR) (Hermes 2020) in Cologne, which operated until 2000, or the Institute of Electroacoustic Music in Bourges (IMEB), closed in 2011 (cf. https://misame.org/). Many other important centers have closed, and many archives have been for ever lost when they could not have be saved in extremis by researchers or enthusiasts.

Even in creative centers still in operation, it can be quite difficult to find archives as can be seen for example in the investigative work of Kevin Dahan on the Center For Computer Research in Acoustics and Music at Stanford (Dahan 2018).

During a recent survey (Bonardi 2020), it was observed that works created within the French National Centers of Music Creation were very rarely accessible because they were not archived. This survey shows that the cycle of documentation, storage, and updating involved in the preservation of computer music systems require human and financial resources that the majority of creation centers do not have.

State

The Bibliothèque Nationale de France is the depositary of all that is published or distributed in France:

> *"Established in 1537 by François Ier, 'Depot Legal' allows the collection, conservation and consultation of documents of all kinds, in order to constitute a collection of reference, an essential element of the collective memory of the country. It is conceived as the memory of the cultural heritage disseminated on the national territory and therefore includes foreign works published, produced or disseminated in France."* (https://www.bnf.fr/fr/quest-ce-que-le-depot-legal, last access Aug. 2020)

'Depot Legal' also includes printed music and is suitable for digital media that appeared in the 20th century: legal deposit of audiovisual documents, digital documents, websites (net archives).

National archives based on state institutions and legislative texts (in this case Article L131-2 of the Code du Patrimoine) seem to be the most capable of guaranteeing reliable heritage conservation over the long term. Nevertheless, it must be con-

sidered that the repertoire in question is internatinal. Works created in France can be reinterpreted in other countries, or be the fruit of collaborations between studios and composers of different nationalities.

United Nations

As early as 2003 in its Charter on the Preservation of the Digital Heritage, UNESCO affirmed that

> *"Unless the prevailing threats are addressed, the loss of the digital heritage will be rapid and inevitable. Member States will benefit by encouraging legal, economic and technical measures to safeguard the heritage. Awareness-raising and advocacy is urgent, alerting policy-makers and sensitizing the general public to both the potential of the digital media and the practicalities of preservation."* (UNESCO 2009)

Conclusions

We have mentioned (probably non-exhaustively) various actors owning responsibility regarding the preservation of electroacoustic music works. But it seems that none of them can properly fulfill this mission. We believe that the solution lies in a collective effort of all these actors. This common commitment will not emerge without a unifying project and a common preservation environment. This project must also be based on a perennial institution that can ensure its own sustainability.

We have also identified the difficulties inherent in preserving this repertoire. There are pitfalls to be avoided for the preservation to be effective, and to prevent the historical period we are living through from disappearing in what some authors or historians of the future may call the "digital black hole of the 20th century". Unfortunately, most repertoire preservation initiatives have failed on these pitfalls, as evidenced by the long list of missing projects identified by the AFIM working group. In fact, many preservation projects rely on unsustainable funding or institutional support. This leads to the following paradox: preservation projects fail to preserve themselves and evaporate when the project ends. What I call "metapreservation" is the preservation of the preservation projects infrastructure. It is vital for preservation projects to think from the start of finding technical, financial and human means to ensure their survival.

This goes through the need to build trusted digital repositories as defined in RLG-OCLC (2002).

The need for such structures is urgent, because the longer we wait, the more musical pieces will be lost and the more difficult will be the task of finding or interpreting documents to re-perform the music from the end of the 20th century.

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