

Université de Montréal

**The digital revolution:** how technology  
changed the workflow of composers for media

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**La révolution numérique :** comment les technologies  
ont changé les méthodologies de travail pour les compositeurs à l'image

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the workflow of composers for media**

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## Introduction

The digital revolution in the music industry has reshaped the way composers for screen work. From the heritage of the Golden Age of Hollywood to sound banks and virtual instruments, technologies have brought forward new workflows and creative possibilities. I would like to introduce the subject through the span of three key dates:

In 1908, again in France, Camille Saint-Saens was commissioned to write what is believed to be the first film score tailored for a specific film, *L'assassinat du Duc de Guise*. This score was successful, but because of the added expense of commissioning a composer, preparing the music, and hiring the ensemble, the concept of scores specifically composed for a film did not take hold. (Davis, 2010, p. 5)

In 1963, Delia Derbyshire composed the main theme of the *Doctor Who* series (Jones, 2016), at a time where computers were non-existent in the general use. Using mostly magnetic tapes, scotch tape and a pair of scissors, Delia Derbyshire created an innovative and legendary theme.

In 2020, the global Covid-19 pandemic has forced workers to reconsider their way of working, has favored the use of videoconferencing services, and has obliged people to work through measures of social distancing.

Within the span of a century, from 1908 to 2020, the composition process has evolved drastically. The emergence of digital technologies has completely changed the workflow of composers nowadays and this is what I wish to explore in my research.

The goal of this research is to show how technological evolutions led to a change in the workflow of music composers for screen, whereas screen refers to films, video games, television shows and advertising.

What drove me to do this research is to explain how the process of making music has become more accessible and has allowed for people that had no musical theory background to consider making a career out of making music for screen. As someone who has not received a classical music education in my childhood, it seemed important to me to take the time to explain how having a solid determination and motivation,

without having been trained musically to classical writing, can lead to pursuing a career in the music composing business. Through an extensive knowledge of audio technological tools and by learning a wide variety of instruments, I have managed to produce music on a professional level.

There have already been some researches on that subject: *Capturing Sound: How technology has changed music* by Mark Katz, *On the track* by Fred Karlin and *Music and Capitalism: a history of the present* by Timothy D. Taylor. These books all explain how the course of history and technological evolutions have shaped the workflow of music composers, all domains included.

My intention is to show how new technologies have allowed composers from a multitude of background to gain accessibility to the field of music for screen, and how they allowed for alternative workflows to emerge. The era that I wish to cover is from the late 1940s, when the Chamberlin was created, to 2020, our present time. The research will focus on our present time, but we will examine first what were the stepping stones that paved the way of the digital revolution.

The research will be separated into three major axes that all focus on different evolutions within the workflow of composers: the first axis will talk about the historical evolution of technology and the legitimacy of electronic scores. The second axis will focus on the accessibility to more powerful technologies has allowed for new creative workflows. Finally, the third and final axis will deal with changes in the workload and in the means of communication.

## I. From technological evolutions to the legitimacy of electronic scores

The 1940's marked the beginning of the use of electronic music in film music. Thanks to the instruments invented at that time, avant-gardists incorporated this new and experimental aesthetic into the then highly codified field of film music. This resulted in a profound change in the working method. The use of sound synthesis became more attractive, until it became widespread with the arrival of digital audio in the 1980s.

First, we will examine how the evolution of audio equipment has participated in a change of workflows for music composers. Electronic instruments, Digital Audio Workstations, synthesizers and samplers have shaped the way composers work.

In the first part, we will focus on a time frame from the creation of the Chamberlin in the late 1940s, the first sampler ever to be commercialized, to the controversial scoring of *Forbidden Planet* by Bebe and Louis Barron in 1956, up until the scoring of *Chariots of Fire* by Vangelis, in 1982, a score solely done with synthesizers that received praise from the critics.

In the second part, we will talk about the place of electro-acoustic music in scores today, with notorious scoring examples such as *Gravity* scored by Stephen Price, how Hans Zimmer's touch has greatly participated in a gain of popularity of electro-acoustic music in film scoring and finally how composer Hildur Guðnadóttir scored the television series *Chernobyl*.

### A. From the Chamberlin to *Chariots of Fire*

A widely used method in music for film is sampling: "a process in which a sound is taken directly from a recorded medium and transposed onto a new recording." (Fulford-Jones, 2001) Sampling sonic sources has allowed composers of all genres to expand their musical possibilities in many different ways and gave birth to sound banks and virtual instruments, which we will talk about in the second major axis. To understand where today's technologies come from, we will talk about The Chamberlin, the first musical sampler to be commercialized in the United States.

## 1. The Chamberlin

Harry Chamberlin, in the late 1940s, founded the company Chamberlin. This company manufactured the Chamberlin, an instrument considered to be the first ever musical sampler.

Instead of the electronic circuits and digital processors used to generate sound in most synthesizers, Chamberlins replay the sounds of existing instruments and effects recorded to electromagnetic tape. In using prerecorded sound, Chamberlins are considered forerunners of digital sampling techniques and technologies. (Devine, 2013)



*Figure 1 Chamberlin taken from the website nordkeyboards.com © 2019 Clavia DMI AB*

The first Chamberlin had the capacity of playing a recorded tape with a duration of eight seconds. Then the tape had to be rewind to be played again. At that time in the business of music for film, music composers for screen were solely romantic composers.

The Golden Age of Hollywood had composers such as Max Steiner, Miklos Rosza or Erich Korngold who had a solid training in romantic music writing. Their workflow consisted of writing the score by hand and then have the score played and recorded by orchestras in music studios.

The strongest musical influences for them were 19<sup>th</sup> century late Romantics: Wagner, Brahms, Mahler, Verdi, Puccini and Strauss. The musical vocabulary of these composers became the most common and fundamental language of the music in early Hollywood films. (Davis, 2010, p. 29)

Composers were almost exclusively people who had a background in classical writing at this time, and therefore the apparition of tools such as samplers brought controversy amongst composers and musicians. Traditions are hard to break, and samplers were generating questions and fears. One of them was that:

The American Federation of Musicians imposed limitations on the use of Chamberlin keyboards in live settings during the 1960s, fearing that the device's ability to play back multiple instruments at once would put other musicians out of work. (Devine, 2013).

This fear of sampling at the time shows that there was a lot of questioning on the legitimacy of sampling, and how it could possibly put musicians out of work.

Electronic instruments were not widely known, and it took a lot of time for them to be actually considered as music instruments. This brings on the table an interesting element that was subject to debate: the recognition of electronic elements as legitimate scores. Electroacoustic scores were not considered music and brought controversy.

## 2. The legitimacy of electroacoustic scores

The first entirely electronic music score was from the film *Forbidden Planet* by Fred M. Wilcox in 1956. The score was written by composers Bebe and Louis Barron, who both studied music at the University of Minnesota and the University of Chicago. Using tapes, electronic circuits and effects such as delays and reverberations, they composed a score that was defying the tradition of the Hollywood symphonic writing for films. In an interview with Jane Brockman, Bebe Barron explained why they decided to use such tools to score the film:

We were both musicians, but he was self-taught totally in electronics, and I think because of that he felt free to use electronics in a way that they'd never been used before. He didn't feel hampered by any formal knowledge. And Varese, who used to hang out in our studio, defined music as organized sound. This had a great deal of meaning for us. (Brockman, 1992)



*Figure 2 Bebe and Louis Barron in their studio, taken from soundworkscollection.com © 2020 SoundWorks Collection*

Electronic circuits gave them a sense of freedom. The ability to explore new tools and use them in a unique way that was never done before gave them the feeling that they were not obstructed by certain rules that could be established in music.

Their score for *Forbidden Planet* drew critical praise, but a dispute with the American Federation of Musicians prevented them from receiving proper credit for the soundtrack. Their names were also left off the film's Oscar nomination. (Stone, 2005)

Using tapes and manipulating sounds was not considered music when the film was released. Traditions are strong and avant-gardists have to break the ice in order for new techniques to be approved by the mainstream public.

In 2020, it would be unthinkable not to write the composer's name simply because the score would be solely made from electronic elements. The evolution of music, especially through the works of electroacoustic composers like Pierre Schaeffer or Luciano Berio, has allowed for electroacoustic music to be recognized as a whole.

It took a while for the film industry to acknowledge the use of electronic elements in scores as legitimate score. This approach was defying the established tradition of the classic symphonic writing. It is only in 1981 that a fully electronic score was praised and recognized as a legitimate score.

### 3. *Chariots of Fire*: a stepping stone in the recognition of electronic music

The soundtrack of the film *Chariots of Fire* composed by Vangelis was a milestone in the acceptance of electronic music as a legitimate way of scoring a film.

This score was entirely electronic, with no acoustic instruments at all. The synthesizer technology at the time was primitive compared to today. All Vangelis had to work with were analog synthesizers, since digital had yet to arrive. (Davis, 2010, p. 49)

Vangelis used a Yamaha CS-80 polyphonic synthesizer to compose the theme of *Chariots of Fire*, blended with an acoustic piano. A synthesizer is an “electronic musical device or software program used to generate and combine audio signals, using either analog or digital processes” (Devine, 2013).

The main theme of *Chariots of Fire* was such a big hit that it became the 1984 Summer Olympics’ anthem. Vangelis also won the Oscar for Best Film Score in 1982 for the film *Chariots of Fire*. At last, electronic music elements were praised by the public and critics, and recognized fully as a possible way of scoring a film.

As we have seen, technologies such as synthesizers, samplers and electronic circuits have brought forward new ways of making music. But it took some experimentation and time for the critics to acknowledge electro-acoustic music as a legitimate way of scoring a film. In the next section, we will take a look at what the journey of pioneers such as Bebe and Louis Barron, or Vangelis, led to in electro-acoustic music in scores today.

#### B. Electro-acoustic music in scores today

Electronic music scores are now completely part of the musical landscape in films. There are notable examples of electroacoustic scores that received praise by the film industry. We will first talk about *Gravity* and the recognition it obtained from the Oscars. Then we will overlook Hans Zimmer’s career, a composer who’s had a role in the growing

popularity of electro-acoustic scores. Finally, we'll examine how Hildur Guðnadóttir scored *Chernobyl* with the use of portable recording technologies.

### 1. Orchestral or electroacoustic: Williams or Price

*Gravity*'s score, composed by Steven Price, with which he won the Oscar for the Best Original Score in 2014. Price's score was competing against John Williams's score *The Book Thief*.

Williams freely acknowledges his stylistic debt to various 20th-century concert composers—among them Elgar, whom he greatly admires—and perpetuates the traditions of film-scoring developed by such composers as Erich Wolfgang Korngold, Alfred Newman, Miklós Rózsa, as well as arrangers such as Conrad Salinger. (Palmer, 2013)

John Williams is a composer who is in the continuity of the Hollywood symphonic writing tradition. The fact that Steven Price won the Oscar with a hybrid score, while competing against John Williams, one of the most proficient and recognized film music composers of all times, shows that electroacoustic elements are legitimized, recognized and rewarded as part of the musical landscape of music for film.

Steven Price discussed his creative approach in an interview for *FilmMusicMag*:

A lot of ideas that started off organic also ended up being treated electronically, like textures that might have derived from guitar strings, or a human voice. A glass harmonica genius named Alastair Malloy, and a great church pipe organ played by Philip Collin also figure into the score. Everything got put through processing until it felt right, especially when it came to making the orchestra have the feeling of how the camera was moving.

Price went to look for noises and sounds, instead of focusing solely on an orchestral writing. In the same interview, the author noted that there were “quite a bit of musical sound effects in the track *Debris*”. (Schweiger, 2013) To that, he answered:

That was something that was opened up to me by the idea that there was no traditional sound design. You see some space films and the explosions are very

audible, and very sound design-y. Alfonso wanted me to try to express things that ordinarily would be sound in a musical way. So, the composition serves a dual purpose in that way. (Schweiger, 2013)

Price found an innovative way to compose the soundtrack of *Gravity* by approaching the composition like an element of sound design. The music is there not only to emphasize what emotions the main character is going through, but also plays a role of support towards the sound design. The duality of the music merging with sound design is something that is more and more frequent: since electroacoustic sounds have a very specific timbre, they can easily be mistaken as sound design elements, and composers like Steven Price use this ambivalence to come up with brand new ideas for scores.

## 2. The case of Hans Zimmer

Another example is the score of the film *Blade Runner 2049*, composed by Hans Zimmer and Benjamin Wallfisch, which is solely done with electronic instruments and percussions. The score was nominated at the BAFTA awards for Best Original Music. Hans Zimmer is, in fact, one of the most known examples of a composer who came from a pop music environment, and who made it today as a major film music composer, having worked on titles such as *Batman: The Dark Knight* or *Interstellar*.

His experience with synthesizers allowed him to offer something different: “Zimmer’s ‘pseudo-orchestral’ (or other hybrid) approach, largely through the use of synthesizers and sampling, has characterized his career in film scoring.” (Bowman, 2013) Taking a new approach, going for something different, is what made Zimmer’s career such a success.

*Interstellar* by Christopher Nolan is a good example of how a different approach to scoring can lead to a musical success. For the score of *Interstellar*, Zimmer wrote pieces for a church organ. There aren’t many examples of blockbusters that have been scored this way. The score was truly innovative and does not embrace the symphonic Hollywood tradition.

### 3. New scoring approaches: portable recorders

A great example of taking a completely different approach to scoring is the one of icelandic composer Hildur Guðnadóttir who wrote the soundtrack for HBO series *Chernobyl*, directed by Johan Renck in 2019, a series that depicts the tragic events that happened in the infamous Chernobyl nuclear power plant. Hildur Guðnadóttir “captured field recordings at a now-decommissioned plant in Lithuania, where the series was filmed.” (Shaw Roberts, 2019). The score is mainly made of textures, electronic sounds and organic noises to support the discourse of the horrific events that happened in the power plant.

The use of field recording equipment allowed for a unique soundtrack, where the composer recorded various sounds inside the power plant, wearing hazmat suits. The creation of the soundtrack has been made possible thanks to the portability of technological recording equipment, which also allowed for a different conception of the soundtrack and a different approach on how to score the series.

This would have been extremely costly and complicated to do in the 70’s. Portable recording has become so much more accessible to the grand public thanks to the low cost of production of portable recorders, which allows more composers to use an extended array of tools for their scores.

Composers now have a huge palette of technologies, tools and instruments to work with, and are rewarded for being original and breaking traditions. More and more different creative workflows are emerging and composers are pushing the boundaries of music writing to come up with unique takes on scoring. Though, all these new ways of working have been made available thanks to the ever-growing accessibility to new powerful technologies and resources, and this is what we are going to discuss in the next section.

## II. Accessibility to powerful technologies: new creative workflows

Since the worldwide globalization and the digital revolution in the 80s, up to the overall democratization of digital technologies today, mass production of audio equipment has allowed for lower prices and a better accessibility to pieces of equipment required to make music. In the first part, we will talk about home studios and the accessibility of audio equipment and see how this has made new workflows emerge. In the second part, we will discuss about sound banks and how that revolution shaped the music industry.

### A. Home studios and the accessibility of audio equipment

Talking about accessibility, an interesting workflow change that has been made possible thanks to technological advances and the mass production of audio equipment, is the ability to record everything on your own. As long as one possesses a computer, a sound card and a microphone, one can record anything with a bit of knowledge and practice, in part due to the immense accessibility of knowledge found on the internet.

#### 1. Alternative workflows amongst multi-instrumentalists: Brian D'Oliveira

Brian D'Oliveira, composer of the soundtrack of *Shadow of the Tomb Raider*, has a very unique way of making music. Instead of writing scores for musicians to play, he records and plays everything on his own. Brian D'Oliveira flew to the Southern American continent to dig for all the instruments that could fit the Mayan atmosphere of the game. That way, he collected hundreds of instruments that he brought back and he recorded all these instruments in his studio space, playing them on his own. (*Shadow of the Tomb Raider - Sound and Music [ESRB]*, 2019) This allowed for a soundtrack that is totally unique, and that respects the cultural Mayan heritage.

The soundtrack is a combination of tracks that do create sonic textures to immerse the player into the atmosphere, and tracks that do have a more thematic approach for the key

moments of the story. Having all the instruments in his own studio, Brian D'Oliveira's workflow consists of building a track by improvising on the image. As the day goes on, more and more tracks get added to the piece, some get removed, and so on.

A very useful technique to achieve that is called overdub: it consists in playing a line, and then recording again over that specific line, again and again. This technique allows for a single person to play all the instruments on a single track.

With the very existence of Digital Audio Workstations, the power of today's computers and the easiness of use, one can record himself with just the right gear on his own, and in a very fast and efficient way.

## 2. Alternative workflows amongst multi-instrumentalists: The Flight

This type of workflow is becoming more and more popular amongst composers. The duo of composers The Flight, who composed the soundtrack of *Assassin's Creed: Odyssey* have a similar way of working. What's interesting to point out is that massive, expensive studio spaces fully equipped are not necessary anymore to compose music for screen. As we can see in this article:

The Flight's London Studio is a space that's evolved from making barrels to making music, and it's not entirely soundproof. In many cases, that would be a problem, but for one of the cues, Happy Family, the birds outside the studio joined in the music, adding some authentic real-world sound that works perfectly with the springtime setting of the game. (Remington, 2018)

As we can see in this quote, the studio that The Flight used was far from being soundproof. Though, instead of trying to achieve sonic purity, they used that as an actual strength and turned some of the issues they had into elements that would become part of the score. It's mostly a matter of being creative and trying to be as creative as possible, even if one's studio is not as professionally equipped as classic recording facilities such as Abbey Road Studios.

The accessibility of technological equipment has allowed for more people to have their own home studios. This changed the musical landscape drastically: instead of having to

pay to rent a studio space, which can be very expensive for low budget productions, composers now own all their equipment at home. It is a very cost-effective way of producing music for multi-instrumentalists. It also allows classical composers to produce demos at home.

### 3. An example of reduced equipment cost: the comeback of analog synthesizers

Audio equipment has been made much more accessible because of globalization and market competitiveness between audio gear companies such as Yamaha or Focal. An interesting trend to look at is the comeback of analog synthesizers on the music scene.

Today, analog synthesizers are back. The web is full of discussions debating the relative pros and cons of “hardware” and “software” synthesizers. The “hard” – or analog – synthesizers are renowned for their durability (no software updates or bugs to worry about) and ergonomic, tactile controls. The sheer physicality of analog synths can make the sound designer or performer feel as one with the creative process. Hard synths are also said to each have a unique character that one eventually internalizes and which can lead to better, more efficient workflows and more individual creations. (Teufel, 2015)

The ability to control elements through physical and analog inputs brings a different feeling to the performance. The company Behringer is now producing copies of classic synthesizers, such as the Arp Odyssey, but at a fraction of what the price of such a synthesizer would cost, which makes synthesizers more accessible than they have ever been. It seems this trend is also in reaction to the overall digitalization of the music-making process: composers are willing to obtain more organic sounds, and to have tools that do not necessarily require a computer.



Figure 3 Behringer's copy of the Arp Odyssey, a classic analog synthesizer, taken from [musiquedepot.ca](http://musiquedepot.ca)

Classic analog synthesizers have also been made much more accessible thanks to the expanding market of virtual instruments, which we are going to talk about in the next section.

Because of mass production, globalization, reduced costs, and the fast expansion of music technologies, music composers now have access to a huge panel of tools to compose, which allows them to come up with new creative workflows. In the next section, we are going to talk about sound banks, and how they shaped the job of music composers for screen.

## B. An orchestra at home: the revolution of sound banks

Two major tools that allowed composers to cut the costs of production are sound banks and virtual instruments (also called VSTs), and they were a complete revolution in the

music world. A virtual instrument is a “term for computer software designed to simulate or duplicate the functionality of other instruments.” (Smith, 2014) “Virtual instruments are played by means of a connected MIDI controller (keyboard, drum pads, etc.) and heard through the computer’s audio output.” (Smith, 2014) The concept itself is quite simple: a team of sound technicians and engineers record sounds, and then these sounds are played back in the software, which allows the person owning the software to have a huge palette of sounds, free of rights. VSTs were “created in 1996 by Steinberg Media Technologies GmbH” (Smith, 2014), the same company that created the digital audio workstation Cubase.

1. The increase of processing power on personal computers

Since 1996, VSTs have evolved drastically. The increase of processing power, storage capacity and RAM (random-access memory) in computers has allowed VSTs to become incredibly powerful.

For example, in 2003, the companies East West and Quantum Leap released “Symphonic Orchestra”, a VST available on Windows XP and Mac OS X, which goal was to sample a full symphonic orchestra. The full Platinum edition required 138.3Gb of storage capacity. (Stewart, 2006)

In 2019, Spitfire Audio released BBC Symphony Orchestra, a VST available on Mac OS X 10.10 and Windows 7 and more. The goal of this VST is also to allow composers to have access to the full palette of sounds the orchestra has to offer. However, this sound bank requires an average of 600Gb of storage capacity. This is 461Gb more than East West Symphonic Orchestra Pro XP. In terms of specifications, Spitfire’s BBC Symphony Orchestra requires a recommended 2.8GHz i5 minimum (quad-core) processor, and 8GB of RAM. (*BBC Symphony Orchestra*, n.d.)

On the other hand, East West Symphonic Orchestra Pro XP required a Pentium III/Athlon processor of 1GHz, and at least 512MB of RAM. The difference in terms of requirements is tremendous, and shows how, thanks to the development of personal computers, virtual instruments have become much more powerful and resourceful. That gives composers very powerful tools that they can use on their own computers: a higher processing power

and a higher random-access memory means that the computer can playback more virtual instruments at the same time.

In modern sound banks, like BBC Symphony Orchestra by the company Spitfire, there is now the option to add different microphone positions in the virtual instrument. There are up to eight different positions, which means that every single position used requires processing power and RAM to function. This is an incredible upgrade for composers, because the sound they obtain from the banks today are much more detailed and precise, and allow for a better quality overall, and thanks to the accessibility to powerful computers and parts, it is now possible to build a machine that can handle an intensive usage at an acceptable cost.

## 2. Composing faster, cheaper, at home

This evolution has allowed composers to have basically any sampled instrument playable at the tip of their fingers. The result of that is that composers can now access sound banks very easily to produce music in the comfort of their own home. It is now possible for a person owning a decent personal computer to produce an orchestral track without even needing any instrumentalist recording. The cost difference is tremendous between recording a full orchestra, compared to producing a fully digital orchestral track, and therefore allows more composers to have access to scoring orchestral music for screen.

Furthermore, the ability to modify the musical parameters instantly allows for a largest error margin. Making a mistake in the score was expensive in the 70's, since it could not be undone and it was nearly impossible to edit. With sound banks, it only takes a few clicks to correct a mistake, which is a huge time gain for composers, but also relieves the stress of having to correct mistakes in real time at the studio, with the orchestra waiting to record.

However, there is a downside to the use of orchestral sound banks: as much as they can sound well, a trained ear will most often notice that the sound is being made by a sound bank instead of an actual orchestra. In order to make an orchestral sound bank sound like a real orchestra, it requires hours and hours of programming, which is tedious and

complicated. There is a human factor that comes into play when instrumentalists play their instrument, which is extremely complicated to mimic.

A common trick that is used to “hide” the virtual orchestra is to record a few real instrumentalists, that will be placed a bit more in the front of the mix, and to make them blend with the sound bank. That way, the human ear is tricked into believing that the orchestra is real. This technique makes lower production costs and provides an overall pretty good sound, if the programming is done correctly. Though, bigger productions with bigger budgets will most always prefer to pay for a real orchestra.

Sound banks do however require a lot of storage on computers. This is why we are going to talk about storage tools on computers and how their evolution has allowed for bigger and more detailed sound banks.

### 3. Hard drives to solid-state drives: a major upgrade performance-wise

A technology that has allowed composers to be even faster in their production is the emergence of SSDs (Solid-state drive). At the beginning of the 21<sup>st</sup> century, the HDD (Hard Disk Drive) was the most accessible technology that allowed data storage on computers. The role of these drives is to store data on computers. They are essential to the functioning of computers.

A traditional hard drive contains a circular disc – known as a platter – that stores your data. The disc spins, allowing the read-write arm to read data on the disc (or write data to it) as it passes. The faster the platter spins, the faster the hard drive works, which can impact how quickly your operating system responds, and how long it takes applications installed on the drive to load and open. (Hanson, 2019)



*Figure 4 Comparison between a HDD and a SSD taken from the website medium.com*

Solid state drives, on the other hand, use Flash technology to read and write data, which does not involve a mechanical process, and therefore allows for a much faster write/read speed.

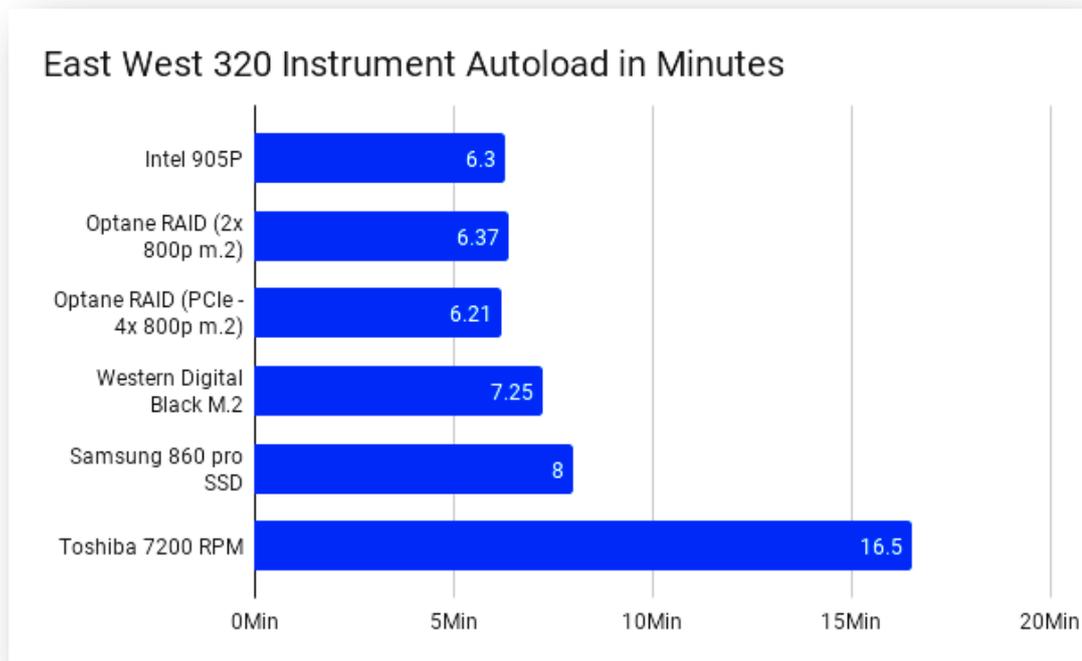
A “SATA III hard drive at 5,400 RPM will have speeds of around 100MB/s, while a 7,200 RPM will be 150MB/s”. (Hanson, 2019) On the other hand, “average speeds for PCIe/M.2 SSDs range from around 1.2GB/s up to around 1.4GB/s”. (Hanson, 2019) Solid state drives are more than 10 times more powerful than former hard disk drives.

This technological evolution has had a tremendous impact on music composing: from the ability to load sound banks way faster in a digital audio workstation, the load time that is reduced to open software, to the ability to transfer heavy video files faster, the time gain in the end is drastic. The time spent waiting for the computer to transfer or process ends up being much shorter, which leaves more time to actually compose music.

A study on this matter has been done by Brian Lorelle, called *A Comparison of Storage Mediums for Sample-Based Plugin Load Times in Pro Audio Applications*.

The goal of this study is to compare various storage mediums and their ability to load sample-based materials for audio production. This study will approach this

practice from the standpoint of a professional music composer or producer. Most people in this position are in need of the ability to load large numbers of sample-based instruments quickly and efficiently from inside their Digital Audio Workstation (DAW). Decreased load times lead to less time spent searching for sounds, and more time being creative. This time gained leads to money saved, as work can progress more quickly. (Lorelle, 2019)



*Figure 5 East West 320 Instrument Autoload in Minutes, taken from Brian Lorelle's study © pcaudiolabs.com*

As we can see in the graph, the Toshiba hard disk drive with a speed of 7200 RPM (Revolutions Per Minute) takes 16 minutes and 30 seconds to load the entirety of the sound bank, whereas a Samsung 860 pro SSD connected via SATA will take 8 minutes. The Intel 905P connected via PCIe is even faster, with a loading time of 5 minutes and 18 seconds.

This increase in performance is tremendously helpful for composers, since a time gain also means a profitability gain. As the conclusion of the study suggests: “the amount of time gained by upgrading to a faster SSD such as the Intel 905P varies from 20% to almost 90% less time spend loading samples.” (Hanson, 2019)

The increase of processing power, storage capacity and speed of transfer therefore allows composers to compose faster and make modifications much easier than before. This change, however, implies two major changes in the workflow of composers: the speed of production, which leads to bigger workloads, and the communication process with teams.

### III. Changes in the workload and communication

Composing for cinema, video games or advertising requires a collaborative work with other artists, directors or producers, who are not necessarily musicians. In most cases, back and forth exchanges are necessary to obtain feedback. A clear communication must be set in place between both parties to ensure the completion of the project.

It is clear that with technological evolutions, the whole production chain of media content has evolved. The first thing we will talk about is the workload for composers and how it affected the speed of production. Then we will see how internet shaped the way we communicate, and how that affected the means of communication used by composers to discuss and obtain feedback from the people they work with.

#### A. Workload evolutions: the speed of production

With faster computers inevitably comes a faster production speed. What we can ask ourselves is: is that necessarily a good thing? First, we will overlook the workloads in the film industry for music composers. Then we will see what the workloads have become in the video game industry.

##### 1. Workloads in the film industry

In the book *Music and Capitalism: A history of the present*, the author Timothy D. Taylor interviewed Chris Wong, a film composer, in 2012. There are a few points that we will highlight in this interview. First of all, Chris Wong says:

The biggest irony behind everything is that you would think that with all these computer technologies, things would get more and more efficient, but I feel like they've gotten less. It's just made it so that people feel like they can change things more often without facing the consequences of it. But I feel like the situation's gotten worse. Because what has happened is, it's made everyone believe that you

can change everything at the last minute, because you have a computer now. (Taylor, 2016, p. 143)

The speed of production can have a negative impact on the workflow of composers. With clients being aware of the possible speed of production, they tend to ask for changes more often until the last minute. And since movies are not being edited on physical films anymore, but through software and computers, changes can be done at any time in the process, which allows for last minute modifications without necessarily impacting the whole production chain. Further on, Chris Wong says:

As a result, I feel like the schedules have gotten harder and harder. When I was studying with Jerry Goldsmith in the late 90's, what he told us was that six weeks was considered reasonable for a feature. And that's for someone who's pretty experienced and writing very quickly. [...] These days, if I can get six weeks, I feel very fortunate. I think the film I did in December was on a four-week schedule. [...] The composer is always screwed on the schedule, because music is one of the last things that goes in the picture. And you can't change the release date. People have legal obligations to put the movie in the theater by a certain date. (Taylor, 2016, p. 143)

If we combine the fact that the schedules are now tighter than before, with the fact that there can be changes done at the very last minute, and that the amount of music required for films has not changed, the result is that the composer has to produce more music, faster, within a shorter time frame. Capitalist shaped the way the audiovisual industries work, and it has clearly affected the way composers have to work.

This change inevitably leads to more pressure on composers, and they have to adapt their workflow in consequence. In another interview, Timothy D. Taylor asked Craig Pettigrew, a music editor, his thoughts on schedules getting shorter and the increased pressure for composers:

Technology has changed everything except the creative decision. But the conception is that technology has changed literally everything. So, the demands are far greater, and there's far less time to do the same amount of work, or even more work. But it's a wall that we have to be finished by, and this is our time to compose and orchestrate and record and mix. That time is shrinking all the time [...] Technology has really changed the perception of what it takes to create

recorded mixed music, and you get on a show, and there'll be just an unbelievable stress level because of it. (Taylor, 2016, p. 144)

This is an aspect that is not necessarily thought of when we think about technological evolutions, but the stress that workers need to deal with has become higher because of technological progress. In that case, technological advances are therefore bringing a negative aspect to the composition process, which can weight on the composers and the music production team. This element is directly linked with the constant necessity of growth, of producing more, faster and cheaper that capitalism brought.

## 2. Workloads in the video game industry

In the video game industry, the way to compose music differs from films. The amount of music required is usually way higher since full narrative game can have a playtime up to a hundred hours. The workloads in this industry keep getting bigger and bigger too. The development tools are changing rapidly and requires composers to adapt music scoring to these new tools. We will first overlook what is at stake for music composers in video games and what adaptive music is, then we will take a look at *Horizon Zero Dawn*, an open-world game, and see how composers managed to make music for that title.

### a) *Adaptive music and its implications*

In decades, the music has changed from being looped segments to being fully adaptive systems, that reacts to whatever action the player is doing in-game. This adaptability comes at a price: more music needs to be created and integrated for the system to work. In the conclusion of *Writing interactive music for video games* by Michael Sweet, the author depicts what the future of game scoring will be:

For video games scores to be more innovative, it is likely that we will need to collect more data from our games and interpret those data to adapt the music in real time. The level of detail needs to be subtler and more interesting. Avoiding the obvious trappings of broad music state changes to maximize subtlety in the

stories that we're trying to tell is what lies on the horizon in music innovation for video games. Meeting this goal will require developers, publishers, and composers to experiment with new scoring methods and new music system designs. (Sweet, 2015, p. 424)

Composers have to come up with entire music systems to immerse the player. It is not a “horizontal” way to compose music that is asked from the composers. Since the actions are defined by the player, there is no timeline. One could take ten seconds to do a specific action, but another player could decide to not move and stay ten minutes in the area. Therefore, the challenges of composing music differ from the ones in films.

In order for the game to be immersive, the music has to be composed using systems that can vary from very simple to extremely complex, and this adds more pressure on the shoulders of composers. On major titles, they will usually work in teams with the audio director, and it is common to have more than just one composer for a AAA game.

Our research focuses on the communication between teams and on the workload that represents interactive music composing for a video game, therefore we will not detail precisely the specificities of interactive music composition. In order to obtain more information on how this works, I would recommend the book *Writing interactive music for video games* by Michael Sweet, which depicts the challenges of writing interactive music for composers.

To illustrate the challenges of composing music for a big budget video game, we are going to take a look at what the workloads represent by examining the work process on the game *Horizon: Zero Dawn*.

b) *Horizon: Zero Dawn: workloads on a “AAA” title*

The “AAA” classification regroups games with the highest development budgets, which means that these games are developed with huge teams, and that the quality expectations are very high. It would be comparable to what we call “blockbusters” in the film industry.

In the game *Horizon: Zero Dawn* developed by Guerrilla Games, the composers (The Flight, Joris de Man and Jonathan Williams) made various systems to ensure that the

music would be adaptive to the environment and to what the player does. In an interview by *Kotaku* magazine, Joris de Man says:

We also had different tracks for night-time; at night the mechanical creatures are more dominant, and so the musical textures would be more electronical, with the organic elements pushed to the back. (Simpson, 2017)

They developed a specific system based on the day and night cycle, where the night would feel more electronical while the day would feel more organic. Composers have to keep in mind that the content in-game is constantly evolving. In order to compose the soundtrack, they must not only score to what happens on the screen, but they must create stems that can adapt to the environmental changes, which adds a supplementary charge to the workload of composers for games. On a feature film, the average time of music that will have to be composed for the film averages between forty minutes to two hours.

For a big budget, open-world game such as *Horizon: Zero Dawn*, they had to manage to produce up to four hours of music. In another interview by Tom Flint, the composers and the music director talk about the workload that represented the work on *Horizon: Zero Dawn*:

One of the main problems the team faced was simply creating enough in-game music — the average player is expected to take approximately 40 hours to complete the whole game. Between them, the composers were asked to produce about four hours of material, which had to be supplied in such a way that it could be rearranged to make new pieces. “You don’t want a lot of repetition, but realistically, you can’t write 40 hours of music,” says Joe, “so you have to write music from which the producers can keep using assets and playing them in different ways. Our music was supplied in kit form so Guerrilla could explode it out and use it within the music system. We’d write a listening version and then they’d ask us to expand the bits they liked. Then we saved that as stems which could be used with each other or on their own. (Flint, 2017)

Composers have to create a musical experience for a story that can take more than forty hours to be completed. As stated above, composers and music supervisors have to think of systems to ensure that the player does not get bored musically while still keeping a manageable amount of music to produce. This is achieved through the use of middleware, “software packages that provide an interface between the music and the game engine”

(Collins, 2013). This means that composers have to, on top of being agile and efficient on music composition software, be able to understand and work within middleware such as *Wwise* or *Fmod*. It is a supplementary skillset that adds to the workload of composers for video games.

As we have seen, the workloads have gotten bigger through the years, and composers need not only to compose music, but to also develop a knowledge in music systems when it comes to composing music in video games. Still, one element that definitely shaped the job and how it changed is the evolution of the means of communication.

## B. Changes in the communication methodology

Communication between composers and directors or developers is crucial to the completion of the score. A good communication often leads to good results. Composers have to be smart communicators and a lot of back-and-forth is required in the composing process.

Internet has shaped and defined how communication is done today. Thanks to the fast bandwidths that optical fiber connections now offer, it has become extremely easy to communicate via videoconference calls through applications such as *Skype* or *Zoom*. In 1970, it would have been impossible to score a film without having in-person meetings between the composer and the director.

We will first take a look at how, today, a composer can supervise the recording session of an orchestra remotely. Then we will examine how communication technologies such as videoconference calls, emails and phone calls changed the way composers communicate with their team. Finally, I will talk about a personal experience where I composed music for a short film without ever meeting the director in person.

## 1. Recording orchestras remotely

With today's technologies, a composer can monitor the recording session of an orchestra while being on a different continent. Thanks to powerful livestream tools such as *SourceConnect*, *Steinberg VST Connect* or *GrooveZoo*, the Berklee Valencia Campus students have been able to record the Budapest Orchestra remotely. They monitored the session while being in the United States. (*Remote Control Recording with the Budapest Orchestra at Berklee's Valencia Campus*, 2013) This allowed the students to give instant feedback to the orchestra by sparing them the travel costs. This is a very efficient way to reduce the budget of a recording session with an orchestra, given the fact that some countries such as Hungary can provide lower fares for an orchestral session too. Services like Czech Orchestra Recordings do provide complete packages and specialized themselves in organizing remote recording sessions.



*Figure 6 Photo of the Rudolfinum Studio's control room taken from the website czechrecordings.com*

## 2. Videoconference, emails and phone calls

Communication has also changed between directors and composers. Instead of face-to-face meetings, they can communicate via phone calls, video conferencing or emails.

Phone calls and video conferencing are useful when, for example, changes to a picture edit are to be discussed or feedback given on materials previously shared. Perhaps the composer has sent over some revised demos and now they need to get

feedback and/or the final sign-off. Emails can be useful if the parties involved are not able to meet or speak at a specific time. For example, the composer may be working in a different time zone, or the director is shooting on a remote location. (Hexel, 2018, p. 216)

The ease of communication has tremendously helped composers to obtain faster feedback on their changes and modifications. Through my experience of being a music assistant for Brian D'Oliveira, I worked on the Netflix series *Gentefied*. Very often we have had to modify a cue up to five times in a single day. Though, at the end of the day, the cue was finished and validated by a team of four people. The whole production team was located in Los Angeles, while we were located in Montreal.

This allowed us to obtain immediate feedback from the team, and therefore we were able to modify the cues quickly. This allows for a faster production speed, and it is even more interesting when composers work on series that have a lot of episodes to score with a lot of content to create. That working speed and efficiency could not have been achieved without the powerful communication tools that we have today. The ever-growing internet speed also played a major role in this evolution.

### 3. Scoring with no in-person meetings

It is also possible to score a film without ever meeting in person. In February 2020, I scored the short film *Beneath Us*, directed by Faisal Lutchmedial, without having a single video conference call or meeting him in person. We had an initial phone call where we both expressed what we thought would be good in terms of scoring, and then we mainly exchanged via e-mails. Sharing tools such as Google Drive or Dropbox were mandatory during this process, since we had to figure out a quick and easy way to send files.

I scored the whole short film in a week, with an initial recording session for all the drums I wanted. Then I collected his feedback, reworked the parts, and sent him the revisions. The experience of scoring without meeting the director is interesting but somewhat very strange. Meeting a person allows for a better connection and a better overall feeling of what the other person expects. But this experience proved me that it was possible, as long as a good communication is set between both parties.

Interestingly enough, a part of the scoring process of this film happened during the Covid-19 pandemic outbreak. I had to finish the scoring of the film while being confined at home. This shows how powerful today's technologies can be in terms of communication means. In an era where we have to prioritize social distancing, it is clear that these means of communication are going to be much more used and favorized.

As we have seen, the workloads have drastically changed for composers, and the way they have to communicate has changed, and will probably change again in the future. Composers have to constantly stay tuned to the emergence of new communication means, as they have to remain efficient and prolific. These tools come with both positive and negative effects on the workflow of composers, but they remain essential to the completion of a score.



## Conclusion

Technologies opened up new creative workflows and shaped the way composers work today.

Orchestral music is still a standard in music for screen, with prominent composers, such as John Williams, who are still active in the industry. However, since *Forbidden Planet*, different composing practices emerged, with the use of electroacoustic instruments and audio synthesis. Today, they appear to have an essential spot in music for film. It is also very common to hear hybrid scores blending orchestral textures with electroacoustic sounds.

Electroacoustic scores have been progressively legitimized, and technologies helped open up the spectrum of possibilities that composers can have to score. They've allowed for new workflows to exist, and helped composers push the boundaries of what scoring for screen can be. They are also more accessible than ever, financially and technically. Home-studios have opened up career possibilities for aspiring composers, and more and more young composers are willing to pursue a career in music for screen.

However, new technologies also brought up certain issues: the workloads have gotten bigger, with shorter deadlines, and composers have to remain on top of their technological knowledge and stay tuned to the constantly evolving software and virtual instruments. Since the accessibility to audio equipment has gotten better, there are also more contenders willing to make music for screen, and therefore composers need to remain competitive in order to succeed.

In my own practice, I am constantly pushing myself to explore new paths in music making. As a composer who has not been through musical studies in my childhood, and who studied sound and audio instead of music theory, I feel grateful that I am able to pursue this dream of making a living out of making music, thanks to computers and technologies. I have developed an energetic and hybrid sound signature. Being a multi-instrumentalist myself, and having started my composing career making electronic music, technologies have been a prime element in my creation process.

Given the actual circumstances of a global worldwide pandemic, it is obvious that technologies are going to be more than ever necessary for our communications and

exchanges between directors and composers in the future. The pandemic situation is anchoring these means of communication, locally and internationally: social distancing is prioritized, and online exchanges are the only way to maintain efficient communication for teams.

The development of newer technologies is bringing up an interesting avenue that is already generating controversy: the development of artificial intelligence that is able to create music on its own. For example, *AIVA* is a company that offers music composing services composed by artificial intelligence. This service can even be used professionally and licensed, depending on the subscription plan.

Another company called *LANDR* offers automated audio mastering services. All it takes is uploading a music track on the website, and thanks to deep learning, “a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks” (Brownlee, 2019), the artificial intelligence is capable of providing a mastered version of the track in less than a minute. And because it uses deep learning, the service just becomes more and more precise as more users keep using it. Through deep learning, machines can learn complex structures, and the musical language is certainly something that can be learned and processed.

As sampling was the controversy of yesterday, artificial intelligence is the controversy of today, and composers will have to keep up with whichever new technology is going to come up in the future of music to maintain their competitiveness. So, to which extent will machines take space in the composition process? Will we still need humans behind computers? And who will get the royalties?

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**Research paper of : Tristan ALANTAR**

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## **Title**

# **The digital revolution: how technology changed the workflow of composers for media**

## **Résumé (Français)**

Les technologies ont façonné et façonnent les méthodes de travail des compositeurs de musique à l'image : en termes de communications, de méthodologie et au niveau des compétences requises. De *La Planète Interdite* au Covid-19, nous examinerons comment les méthodologies de travail des compositeurs de musique à l'image ont changé au fil des ans.

Mots-clés : Musique, Composition, Technologies, Méthodologies, Musique à l'image, Compositeur à l'image, Musique de films, Musique de jeu vidéo, Cinéma, Compositeur de musique

## **Abstract (English)**

Technologies have shaped, and still do so, the way music composers for screen work: communication-wise, in their creative workflow and in their skill sets. From *Forbidden Planet* to Covid-19, we will examine how and in what way the workflows of music composers have changed throughout the years.

Keywords: Music, Composition, Technologies, Workflow, Music for screen, Composer for screen, Music for film, Video game music, Cinema, Music composer