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The Evolution of Audio Processing: Technological and Digital Mediation in Music Creation and Record Production*

La evolución del procesamiento de audio: mediación tecnológica y digital en la creación musical y producción discográfica

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Abstract: This article describes the technical possibilities that, through the use of digital audio processing technology, have influenced the evolution of music and record production, from the musical creation and composition to the distribution of the finished product. As a whole, these possibilities have brought about significant changes not only in the ways of creating but also in the final aesthetic-sound results. An analysis based on primary sources, bibliographic references, and the autoethnographic experience of the authors reveals the influence that these changes have had on producers, engineers, and musicians in the performance of their artistic work. Finally, there is evidence of a strong impact of the technological passage of time on the creative processes and the aesthetic-sound results, which demonstrates, once again, the importance of studies on technology and its effect on traditional arts.

Keywords: Analog audio, digital audio, record industry, music production.

Resumen: el objetivo de este artículo consistió en relacionar las posibilidades técnicas que, a partir del uso de la tecnología digital de procesamiento de audio, han influenciado el devenir de la producción musical y discográfica, y que involucran todo el proceso, desde la creación y composición musical, hasta la distribución del producto terminado. En conjunto, dichas posibilidades han producido significativos cambios, no solo en las formas propias de creación, sino también en el resultado estético-sonoro final. Un análisis realizado a partir de fuentes primarias, referencias bibliográficas y la experiencia autoetnográfica de los autores da cuenta de la influencia que estos cambios han tenido en productores, ingenieros y músicos para el desarrollo de su trabajo artístico. Finalmente, se evidencia un fuerte ascendente del paso tecnológico del tiempo en los procesos creativos y los resultados estético-sonoros que demuestran, una vez más, la importancia de los estudios relacionados con la tecnología y su influencia en las artes tradicionales.

Palabras clave: audio analógico, audio digital, industria discográfica, producción musical.

INTRODUCTION

The Art of Music Recording and Production

A cross-disciplinary analysis that includes music making, technology, digital media, and the music industry should necessarily navigate between disciplines such as communication, musicology, history, and the development of techne and technology. Based on Frith and Zagorski-Thomas' (2012) theories, this type of analysis is part of a new academic field they called the Art of Record Production (ARP), which is in the making in terms of academia and research.

This field started with the first ARP Conference, held in London in 2005 by the Association for the Study of the Art of Record Production (ASARP). Subsequent meetings in northern European countries and the United States have resulted in an increase in the number of college programs, thesis, research projects, and publications about record production or recording arts.

Frith and Zagorski-Thomas (2012) published a compilation book entitled *The Art of Record Production: An Introductory Reader for a New Academic Field*. It recounts ASARP Conferences and their main presentations by professionals, researchers, and scholars in different fields: musicology, semiology, sociology, anthropology, historiography, and audio and sound engineering.

One of the main aspects that motivated the creation of the ASARP was higher education. Frith and Zagorski-Thomas have emphasized that ARP should be cross-disciplinary to cover different study fields: "a project—cross-disciplinary designed to foster a dialogue between academics and practitioners, open minded as to what 'the study of record production' might involve" (Frith & Zagorski-Thomas, 2012).

In popular music studies, countless works about audio recording apply this type of analysis because they do not consider music production or the art of recording as individual disciplines, but as a series of cross-disciplinary projects.

> There are obvious parallels here with the development of popular music studies […] and a key point to make is that the study of record production […] is not in itself a discipline, a field of study with its own clearly defined methodology, but is, rather, a cross-disciplinary project (Frith & Zagorski-Thomas, 2012, Introduction, para. 2).

Moore (as cited in Frith & Zagorski-Thomas, 2012) claimed that, to study of this field, it is necessary to take into account aesthetic considerations related to the act of recording and the decisions that are made in a recording studio, which can be based on current technological limitations. In the same sense, Schmidt Horning (2013) highlighted the importance of audio technology in terms of the final product, especially for producers and engineers who use it in the recording studio as a physical and acoustic space where music is created. Similarly, British musician and producer Burgess (2013) argues that music production is "the technological extension of composition and orchestration" (p. 5).

In this paper, technology, acoustic space, and aesthetics come together to address the subject of this study: processes that changed the ways music has been created and produced at the recording studio. Importantly, musicians and producers in the analog era used tools that produced high-impact aesthetic and commercial results that are still enjoyed by current listeners.

This is not only about audio professionals: the target audience can also identify those sound aesthetics and the change of sound over time—which are determined by factors that are more related to consumption strategies, but also to technological implementation processes. This fact applies to creators and users of this aesthetic creation device—called recording studio—as well as final consumers. That is, this phenomenon occurs for two kinds of audiences: (1) those who lived, worked on, created, and consumed the final commercial records from the analog era and currently know the pros and cons of digital audio and (2) digital natives, whose natural point of reference is digital audio but who particularly revisit aesthetics and technologies to listen to old formats motivated by curiosity or the need to change contemporary sources of sound.

About this aspect, Zagorski-Thomas (2014) proposed a relationship between the recording studio and musicology and eight categories to understand the phenomena that take place during recording sessions and record productions. Among them, three are related to the subject of this paper: audio technology development; its utilization; and consumer aesthetics and influence. It is therefore convenient to identify the differentiating and change-producing elements that have mutated during the evolution of technology and how the latter could influence not only those who took part in the creative process but also those at the end of the chain: the general audience.

On Audio Technology

The history of music production includes milestones of technological development that have diversified and influenced not only production techniques and methods but also the aesthetics of the results. When digital audio was barely emerging as an alternative, full of potential, Stockham (1977) raised some questions: "What will the records themselves be like? What will be their size and shape? What and how much will they contain? What will be their quality? How long will they last? How will they be manufactured and packaged? How will they be distributed and sold?" (p. 892). Certainly, to be able to answer them today, we should describe the changes motivated by the introduction of digital audio technology.

Technological transformation also affects the final consumer, who has been a witness of the way music is consumed, stored, and shared. Thus, there is direct feedback to the industry, who should adapt to the pace of production and consumption in the market. In this regard, Strawn (1997) described seven technological axes that have defined changes in the art of music production:

- Number of channels: mono, stereo, multichannel.
- Storage technologies: cylinder, tape, vinyl, CD, DVD, flash memories, portable music players, the cloud. [1]
- Methods for transmission: electrical, electronic, digital, networking.
- Studio equipment: pro, semi-pro, analog, digital.

Each one of these axes has brought about changes in the way the music market and industry plan their production and consumption strategies.

From Analog to Digital

Beyond the relevance of the axes above, using analog, digital, or hybrid technologies is a multi-field axis that can make differences in the workflows of music production and consumption. In the middle of the 1980s, digital technologies started to revolutionize the way music was produced at the studio. The workflows changed noticeably, and aspects such as practicality, economics, quality, and subjective considerations (such as nostalgia and familiarity with past technologies) sparked discussions about working in the analog or digital domain. Because analog equipment suffers less from obsolescence, nowadays it is common to find analog workflows—which makes it possible to compare these technologies and highlight their differences. The following subsection describes some advances of digital audio in the stages of music production, including consumption.

In the Recording Session

The signal flow has perhaps experienced the least drastic changes because the transduction process and the subsequent conversion during preamplification is still performed the same way. Nevertheless, digital technology offers lower noise floors and a wider dynamic range (Lidbetter, 1987). In addition, the media where audio is stored changed from reel-to-reel tapes to hard drives in Digital Audio Workstations (DAWs). This fact has caused significant transformations in musical performance, workflows, and work dynamics.

One of the most important milestones in the popularization and democratization of music recording was the development and commercialization of desktop AD/DA converters[2] —usually including a microphone preamplifier—which made it accessible and practical for individuals outside the music industry. With these pieces of equipment, expensive tape recorders could be replaced with desktop computers that had hard drives where audio could be stored. Moreover, as computers' processing and storage capacity were improved and bandwidth was increased, it became possible to exchange files and collaborate (almost in real time) in geographically distant recordings.

The recording of musical performance also experienced drastic changes. Digital recording technology definitely changed the paradigm of the music performer because it offers the

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[1] Remote servers connected to the internet to store, manage, and process data.
[2] Device that converts analog audio signals into their digital equivalents and vice versa.

(almost unlimited) possibility of playing something again and again until the "perfect take" is achieved. In addition, easier editing influenced the performing mentality because performers became more interested in achieving that perfect take as they knew they could re-record it at will. This possibility affects their preparation and concentration.

In Post-Production

This is the stage of music production that showed the most drastic changes in terms of workflow and studio economics. Audio processing tasks—which in the past were fulfilled by analog machines connected to a mixing console—were transformed into computer functions: the so-called *in-the-box* processing. In addition, audio *plug-ins*[3] started to perform processing tasks in multichannel sessions stored in DAWs. This meant savings in physical analog equipment, as well as time devoted to the configuration and connections that they demanded.

One of the most relevant aspects of the digital world is how easy it is to *recall* a configuration from a previous recording session or some plug-in and use it again in another one. The literature reviewed in this study includes pictures, diagrams, and loose papers where those configurations were written down for subsequent tasks—something that nowadays is solved with a simple screenshot or saving a template. There is also "technostalgia," the view that the "magic" digital world is not able to recreate the acoustic colors and the sonic qualities that were achieved in the past with costly mechanical boxes.

The debate on the sonic difference between analog and digital audio processors has no end and is as nuanced as the number of mixing and audio engineers in the world. Every one of them will, in their own way, ponder on their advantages and disadvantages. We should also mention the introduction of digitally controlled analog equipment: the best of both worlds a click away.

Prestigious companies that develop plug-ins have focused on the modeling and algorithmic simulation of devices from the analog era, such as classic compressors, mechanical reverb, tape delays, and tube preamplifiers—they can be easily inserted into audio tracks in a DAW (Rumsey, 2010).

Mozart (2014) posted on his website an interesting experiment comparing different classic compressors emulated in plug-ins. For that purpose, he passed a sine-wave at different frequencies through the modeled plug-ins and analyzed the resulting sequence of harmonics. The results show that the digital spectra were very similar to their counterparts in the analog equipment.

Likewise, Mehrnoosh (2021) conducted listening and statistical tests using a hardware unit and a plug-in version of the classic Universal Audio 1176 FET Compressor. Applying the same settings in both, their audible results were perceivably different. Although Palm and Lidholm (2008) and Rosso (2019) had demonstrated that this compressor had been re-edited

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[3] Computer programs that run inside other programs to expand their tasks, capacities, and functions.

multiple times, Mehrnoosh (2021) did not consider the specific version he used for the comparison.

In Music Distribution

The introduction of Compact Discs (CDs) lowered the noise floor and increased the dynamic range of audio recordings. By 1988—six years after their commercial release—CDs started to sell more than their predecessors (vinyl discs). And by 1997, more than five billion CDs had been sold around the world (Immink, 1998). In the beginning, one of the most discussed factors of this storage medium was its "repeatability." An exact and continuous repetition of an analog wave depends on the accuracy of the mechanical equipment used for making copies. In contrast, in the digital world, you only need a chain of binary numbers.

In addition to this advantage, digital audio can be compressed to be distributed online in different formats: MP3, AAC, WMA, OGG, and FLAC. These formats reduced the size of the files considerably, making it easier to send them over networks and storing them in hard drives.

The emergence of illegal *peer-to-peer* (P2P) media distribution systems, in addition to piracy, had a serious impact on the music industry. In 2005, when these platforms were at their peak, Seidenberg (2010) calculated 26.5 billion dollars in losses in the phonographic, filmmaking, and software development industries, which caused 373,000 jobs losses. Music sales (in any format) plummeted year after year until 2011, when the International Federation of the Phonographic Industry (2013) reported a little increase of 0.3% due to the introduction of music *streaming* services, such as Spotify, Apple Music, and Tidal. In 2012, the increase reached 6%.

Music consumption through online systems has not only transformed the way users have legal access to music but also the way artists distribute their work. Paradoxically, with these new distribution systems, we have moved from the era of albums and Extended Play (EP) records to one of singles that contain one song per side of the disc.

This study is supported by the conceptual and theoretical framework presented above, the specialized references, and the ideas of some of the protagonists that witnessed this time of technological change from 1980 to 2000. Its main objective is to understand the impact of global technological changes on the local music industry. More specifically, this article aims to describe the influence of digital audio processing on the work of producers, engineers, and musicians in Medellín—the epicenter of the Colombian record industry—between two decades, the 1950s and the 1980s.

METHODOLOGY

This study adopted a qualitative, interpretive methodology to record experiences that participants have had throughout their careers. As a result, we have been able to describe the particular phenomenon under analysis.

Four professionals in the field of record production were interviewed. Including music producers and engineers in the record industry, they were selected because they met three criteria: (1) they were actively working in the field at the time of the study; (2) they produced popular music genres; and (3) they have directly or indirectly worked for some of the biggest record companies in Medellín.

These interviews were semi-structured. They comprised a sequence of predetermined topic-focused questions (Bernard, 1988) that were distributed by email after the participants' informed consent but before the actual interviews. The questions were formulated based on the authors' previous knowledge and professional experience in the recording arts and audio engineering and addressed the research objectives of this study.

During the interviews, the authors tried to play a non-participatory role and create an environment of trust with the interviewees so that reliable and truthful information could be obtained (Massot Lafon et al., 2004). Using the terminology in the field and the authors' experience with the topic was essential for this purpose because—as this subject is discussed by professionals and students alike—interviewees could more easily open up and adequately talk about each and every one of the concepts. Likewise, they felt comfortable and confident sharing their opinions and ideas. This enabled us to collect the information that was later analyzed.

Each one of the participants met the requirements established for an interview. Considering the aims and scope of this study, the data were not anonymized so that the participants' professional experience in this field could be confirmed.

Now, this paper will focus on the testimonies of four characters in the music industry who experienced and were part of the change from analog to digital audio recording: César Bohórquez, an engineer at Estudio Promix; Tony Peñarredonda, an engineer at Discos Fuentes; Juan Escobar, an engineer at Discos Victoria and Codiscos; and Juan José Arango, a musician and arranger with experience in independent music production for the most important record labels in Medellín. All of them are still working in this field, but their expertise and points of view reveal noticeable differences.

The questions in the interviews were about the professional work that music engineers and producers do inside the recording studio (which is tied and subjected to a commercial record production system) directly as employees of a company or indirectly as independent music producers or engineers. Said questions were aimed at establishing the influence of this technological change (from analog to digital audio) on several aspects: workflow; the musician's performative attitude; the possibilities of technological assistance; musical arrangements; the aesthetic concept of the work; and, finally, the economic factor and its

clear differences due to that change. Importantly, these questions were not aimed at music producers or engineers who specialized in a specific music genre, that is, this study is not limited to a particular music style or genre. Instead, it examines the music industry in general, especially commercial music for mass consumption produced during the period of technological change discussed here.

As the questions were open-ended, their answers were recorded and later transcribed. For this purpose, we rigorously processed the information in four steps: (1) transcribe and classify relevant aspects, (2) establish key aspects regarding the research objectives, (3) cluster key aspects into specific categories, and (4) analyze final results.

Finally, the collected information was compared to the ideas found in the literature reviewed here. The next section discusses the results of the four interviews.

RESULTS

Four aspects were highlighted by the participants, the literature, and the authors regarding the transformation of the recording arts, music production methods, and the influence of audio recording technology: (1) the relationship between analog and digital sound aesthetics; (2) the workflow and the tasks fulfilled by producers and performers; (3) the profession of musical performer; and (4) the commercial factor. The latter aspect is integral to the concept of music production because producers as well as performers should aspire to create, as a result, a value-added product that can be sold in the music market.

The Sound Aesthetics

Perhaps the most relevant artistic factor discussed in the interviews was the aesthetic-sound results of record productions. The participants agreed on the idea that analog sound includes an additional component that its digital counterpart does not necessarily achieve. Although current audio technology can come very close to analog sound, the digital—and analog—equipment that is necessary to achieve it is very expensive. In addition, they present evident differences in sound, even for the untrained ear; for instance, the noise floor of tapes or the *hiss* of the needle on the vinyl record. As they are mechanical friction processes, they have a unique noise that is harmoniously combined with music frequencies and add value to these formats. These aesthetic-sound variations have also been influenced by format and medium changes that have occurred throughout the history of sound recording. An example of this was the leap from mechanical to electrical recording—which sounded more like the source, more transparent, and would become the industry standard (Zak III, 2012).

Schmidt Horning (2012) described a factor of sound aesthetics that is related to the recording spaces. She claimed that, in the golden analog age, music "contained air, dynamics and an acoustic identity that imparted a sense of physical space" (Chapter 3, para. 1). The "sense" that Schmidt Horning refers to is an added value that current listeners can take or leave

according to their likes and possibilities. Nevertheless, the mass consumption of digital music occurs on streaming platforms, where that air and three-dimensionality are not always clearly perceived. In the analog era, recordings were produced in big sound-conditioned studios; these days, that three-dimensionality is artificially applied using software. According to Peñarredonda, acoustic audio sounds better. In turn, Bohórquez claims that, even to his trained ear, perceiving the difference between digital emulations and their analog counterparts is not always easy.

The same could be said about the migration from analog to digital recording. The CDs from the middle of the 1980s and the early 1990s included a three-letter code composed of letters A (Analog) and D (Digital) to represent three processes: recording, mixing, and mastering. Using this code, discs were labeled AAD when recording and mixing were analog, ADD when only the recording was analog, and DDD when the entire process was digital.

According to Zagorski-Thomas (2014), this perception of quality is related to the influence that record productions have on consumers. It was not rare that some labels promoted their recording technology to attract more buyers. The opposite happened as well: some productions bragged about the low quality of their processes, as if they wanted to counter the powerful major labels. As a result, audio was impoverished for aesthetic and commercial purposes.

Using analog or digital technology enables artists to search for a particular sonority or sound aesthetics. However, to find it, it is necessary to possess an implicit knowledge of the workings of the machines that achieved those sonorities to be able to implement them in current record production.

Regarding the comparison between analog and digital audio in terms of sound qualities, Bohórquez claims that an important aspect of the analog world is that it can handle higher levels of saturation and distortion, where the recorded signals could present very interesting colors (personal communication, July 19, 2022). Thus, the quality of analog audio is still relevant because current processing capabilities have been used to produce—through plug-ins that simulate saturation, drive, and distortion—very close reconstructions.

In spite of its disadvantages, digital technology has given many enthusiasts and amateur producers access to music production processes. According to Bohórquez, in the past, musicians played, and engineers recorded. Nowadays, that is difficult to establish, which can be naturally good or bad (personal communication, July 19,2022). It can happen, then, that an untrained individual carries out a production with complete competence. It is not enough to have the best tools if there is no knowledge about or experience using them. However, serendipity can happen at the other end of the spectrum: new producers have entered the market with impressive works filled with new musical ideas. Finally, Bohórquez and Arango agree in that someone who is knowledgeable and experienced can work in a domain or the other regardless because—whether in the analog or the digital world—this person will know how to produce similar aesthetic-sound results.

The Workflow

Unlike sound recording, where the conditions depend especially on the purpose, the other stages in record production were greatly affected by technological changes. As those changes enabled people to make recordings by overlaying tapes and previous takes, the last chord in a song was not the last step: it was the producer who made that decision *a posteriori*. The historiography of sound recording in the English-speaking world since the 1960s is filled with examples of this. At that time, major labels and artists' communication teams were in charge of recording the entire production process, detailing even the positioning of the microphones and the characteristics of the equipment in the audio chain. This can be seen in *Soundbreaking* (2016), starring Sir George Martin, the legendary producer of The Beatles; *This is pop* (2020) and *Get back* (2021), directed by Peter Jackson; and, more recently, *McCartney 3, 2, 1* (2022), starring himself and produced by Rick Rubin, who discuss and contextualize some historic recordings, emphasizing capture and mixing processes. The fact that digital audio was initially rejected by the most conservative professionals was something to be expected. Nevertheless, thanks to its advantages in editing, it gained ground. Bohórquez and Escobar agree on this point.

The workflows and methods have evidently changed. In the past, you needed to prepare the studio and set up the equipment. Now, you open an app on your cellphone to record any audio sample. It sounds simple, but it has a direct influence on the results of record production. An interesting example of this is the set of demos for *Bad* (1987), Michael Jackson's seventh solo album, which was produced by Quincy Jones. The documentary entitled *Bad 25*, directed by Lee (2012), shows that the team that produced the artist's demos worked in their own recording studios, creating samples with 24-channel mixing consoles, analog recorders, and all kinds of similar equipment and audio processors. As stated by Bruce Sweden, the engineer, these demos could be part of the final record (Lee, 2012).

Nowadays, demos are recorded using a simple audio interface with a couple of channels and a variety of virtual instruments that offer a wide range of timbric possibilities. This is a giant step in the recording process because many of the sounds in the demos are considered by the producer. Currently, record production teams are reduced to a couple of people or a single person, but they always use technology to mediate the work and refine musical ideas.

Regarding sound recording, today, many instruments in record production are replaced with their digital or virtual versions. To some, it is more convenient to have the sound bank of a Steinway piano recorded under the best acoustic and technical conditions than to record a lower-quality or mistuned piano. To some others, this sound precariousness will be precisely the aspect that will give character to their work.

In the analog era (or the transition toward digital audio)[4], recording studios were configured with a series of complex connections (Figure 1) that were drawn in maps to guide novice engineers and producers. Currently, this step is completed automatically inside DAWs.

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[4] This period can be between the middle of the 1980s and the middle of the 1990s, when analog and digital music recording and production systems worked in parallel in most studies around the world.

Figure 1. Analog patchbay

Source: Caballero Parra (2010, p. 95).

The difficulty of connecting this equipment required a high cognitive level and imagination regarding the signal flow. This way of "thinking about audio" was drastically changed by digital technology. Although some audio recording software has tried to keep that imaginary route in the virtualized signal flow—cables, patchbays, meters, etc. (see Figure 2)—this process may seem strange to digital natives.

Figure 2. Virtual connections in Reason+ software.
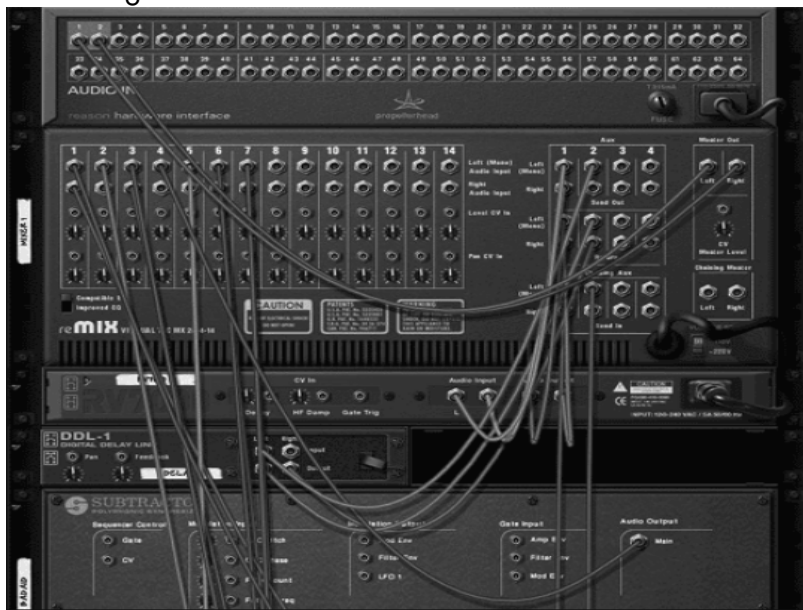
Source: Screenshot of Reason Studios software taken by the authors.

The participants agreed on another point: the processes after audio capture and recording —editing, mixing, and mastering—are easier today in the digital world, where possibilities are almost endless. They also shared similar opinions regarding the difficulties of analog sound: it was hard to calibrate the mechanical systems and synchronize the recorders, and temperature and humidity affected the tapes, causing fungi to appear.

As a result, digital equivalents emulated many of those analog tasks: recording, mixing, and mastering, but also earlier stages such as composition and arrangement. Arango often works with sound libraries (or sound banks) that enable him to simulate not only an entire symphonic orchestra but also exotic instruments that are not easily available in Medellín.

These days, a single signal in a multitrack project can pass through a number of effects and processors. In the analog world, that number was limited. As explained by Peñarredonda, that was precisely where engineers' skills came into play because they needed to manage the devices at their disposal in a smart way (personal communication, June 3, 2022).

Regarding mastering, Escobar recalled the advantages that disc cutting lathes brought to Codiscos. Thanks to them, operators did not need to pay attention to level changes in the phonogram so that the grooves in the disc (stamper) were not damaged—still, some methodical individuals memorized or wrote them down in advance.

The Musical Performance

In the early years of musical performance inside recording studios, musicians stood like in a circus around a horn attached to a disc cutting lathe. That was the time of the heavy and fragile 78 RPM discs, in which each side contained less than four minutes of audio. It was also the peak of big recording rooms where they could record just like they were performing live. The implementation of headphones by the middle of the 1960s was rejected by most musicians. However, this situation was solved with one-ear headphones, which enabled artists to listen to the real as well as the monitored sound—this is important because, through the latter, they received instructions from the engineer and the producer. Later, in the 1960s, multitrack recording started music production as we know it. Albums such as *The Dark Side of the Moon* (1973) or *Boston* (1976) by Pink Floyd—the latter recorded by MIT engineer Tom Scholz in his basement—laid the foundations for a paradigm change in the way music was recorded. After that, a single musician could play all the trumpets, guitars, or percussion in the same project: the "mechanistic" aspect of recording, which started to replace session sound, had came to stay.

As a result, session musicians became strict interpreters in terms of tuning, tempo, and intention, able to generate "perfect" productions where music seems to be performed by a single multi-instrumentalist. The role of music conductor was assumed by the digital metronome and sequences in the DAWs, which determine the performance of the musicians in the project and their aesthetic-sound result.

In-the-box recording environments for the genre currently known as "urban contemporary music" add another component to the performance. They place the artists in a kind of *emotional staging*—using the term proposed by Lacasse (2005) and Zagorski-Thomas (2014)—that aims to transport them to the stage where they perform. For that purpose, they use intimate lighting and a relaxed environment in the studio.

All the interviewees agreed on another idea: in the times of analog audio, musicians showed good preparation and professionalism during recordings, where errors should be fixed in the performance instead of being delegated to post-production. Some even had in mind the premix that should be applied to the song they were recording. As described by Bohórquez, more than ideal performance, time became the most important factor because digital audio made it possible to copy and paste sections and fix errors in rhythmic pairing or tuning,

especially when they were paid by the hour not by song. This advantage enabled musicians to be somewhat more relaxed during the sessions.

Besides the versatile editing functions of DAWs, Peñarredonda and Bohórquez highlighted the introduction of two plugins as milestones in this kind of software: autotune (1996) and Melodyne, respectively. In addition to these tuning tools, the spectral repair suite called Izotope RX offers immense potential in technical, artistic, and creative terms—something that is only possible with digital audio and the capacity of modern processors.

The Commercial Factor

Undoubtedly, the most significant factor that conditions the transformation of the record industry and its production methods is the commercial value of the work. This value includes the sum of the production activities mentioned above. The limit of what can be done with digital technology is determined by the processing capacity of the system being used. Although current digital recording and processing systems are very powerful in terms of processing (algorithmic calculations) and information storage (data storage capacity), during the analog–digital transition, digital equipment was precarious, and it was necessary to combine it with analog processing and equipment.

Importantly, only after the 1990s, the technological change was evident thanks to data storage in hard disks. At that time, Discos Fuentes started to reedit their catalog and offer new versions on CDs and DVDs, as indicated by Peñarredonda. This operation required the company to make substantial investments.

A current DAW can adequately carry out an entire record production, all inside a digital (in-the-box) environment, something that was impossible to achieve in the analog world. There are also hybrid workflows that combine expensive digital and analog equipment. Thanks to their status, they have become an advertisement, an attraction, and part of the "visual aesthetics" of studios that brag about having them to position themselves in the market. In fact, some studios and record labels have kept some analog equipment. Peñarredonda recalls that Discos Fuentes kept some mixing consoles, while Bohórquez indicates that Promix did the same with compressors. In the middle of the 1990s, local record labels in Medellín used to be secretive about and protect their knowledge, techniques, and workflows. This strategy was employed to differentiate them from their competitors. Pieces of equipment, echo chambers, techniques, or even an engineer's ear were the secret weapons that kept them beyond the reach of their competitors.

Regarding music consumption and listening formats, Peñarredonda referred to another difference: cultural changes have transformed a dedicated and often collective experience using speakers in a room into a complementary individual activity using headphones. Beyond old-time rituals, the participants highlighted the electroacoustic difference between listening to music with good sound equipment in a relaxed environment and doing so in crowded public transportation where headphones are one or two centimeters away from the inner ears.

Despite its drawbacks, many current producers and engineers prefer the versatility of digital technology due to its processing capacity, which is much more economical than its analog counterpart. This trend has triggered an interesting race to find not the best process or processing device but that which looks better in the studio. As maintained by Zagorski-Thomas (2014), "the pressure from a market built on gadgets is to alter the technological frame—the problem-solving paradigm—from one based on finding the right process to one based on finding the right 'thing'" (p. 138). He adds, "there is the social field with an equally extensive network of equipment and plug-in reviewers reinforcing the notion that all you need to do is find the right 'thing' to solve your sonic problems" (p. 139).

CONCLUSIONS

The change in the sound aesthetics of record productions is far removed from the aesthetic concept that listeners may want to ascribe to it. In other words, listening to a music production in a specific format or medium in order to find more "originality" is turning away from the real concept of music consumption. This is because, regardless of *where* or *how*, what really matters is *what* we listen to—the medium is just a tool or device for that purpose. The participants agreed on this point. However, the process of music creation and production should be acknowledged as well as an essential step toward the final result.

The interviewees, as well as the authors, hold that work methods and workflows have presented significant changes. For instance, in early monophonic recordings, a few microphones were available, which made it hard to record one take after the other. As a result, the engineer —known as *recorder* at the time—was forced to design "choreographies" of musicians approaching the microphones to achieve the best signal. Now, tracking and overdubbing sessions only need a simple two-channel audio interface to carry out entire productions with multiple channels with their respective chains of effects and processes. Thus, digital technology left a definite mark on the production dynamics of the record industry, especially the protagonists who witnessed the transition from analog to digital.

Nowadays, session musicians or studio performers know very well the dynamics that enable the completion of a record production. Those sessions that lasted eight or more hours (sometimes for months) have been replaced by short visits to the studio. Furthermore, the total working times have been reduced, and, therefore, there have been more opportunities to embark on new projects. In that sense, we can claim that history repeats itself: in the first decades of the previous century, an artist could record an entire album in one or two days using very little post-production.

Regarding commercialization, some artists and record labels are currently using vinyl records in a way that seems paradoxical. This is the case of *14 Cañonazos Bailables*, which started in 1961. More specifically, Volume 1 was recorded on a 1/4-inch tape from which the audio was transferred to an acetate disc and then to a vinyl stamper. As the company did not have the original tape anymore, it was forced to reconvert the record at different sampling rates, resample, and filter the audio using hardware and software.

The final product was labeled AADA, i.e., analog recording, analog mixing, digital transformation, and analog conversion again. In technical terms, this reversion makes no sense because the analog-to-digital conversion broke the audio chain that enabled the sonority and aesthetics that characterize analog sound. At this point, another interesting concept comes into play: technostalgia. It refers to "the recent revival of space-age pop from the 1950s and early 1960s, resurrected […] by intrepid collectors of old vinyl recordings" (Taylor, 2001, p. 12). In particular, such products are aimed at what we could call "technostalgic" individuals. Digital music and record production have especially benefited the production workflow and musical performance due to their economic and time-saving advantages.

In spite of these extraordinary changes, the commercial factor remains the same: offering a consumer good or product to those who demand it. Nevertheless, in record production, the economic factor does not only cover the commercialization of the final product. It should also consider the costs that are intrinsic in the production of the record. And this is where brands and specific products compete to provide the equipment that is used in studios (Zagorski-Thomas, 2014) because this search for the adequate device or "thing" for record production has ultimately standardized the production dynamics of some genres. This activity is reinforced by the audio companies themselves who, through endorsements, turn well-known producers and engineers into peddlers selling their "things." Of course, many of these artifacts are real works of engineering that really contribute to the quality of the works.

Finally, the number of commercialization alternatives has grown exponentially, resulting in a multiplicity of platforms that enable the distribution of music (whether commercial or not). As a consequence, the costs of these productions have been transferred directly to the artist without going through the traditional distribution chain—which has made the most of these media by taking successful projects and releasing them on its own distribution channels. In that regard, the participants who worked directly for record companies agree: music production and commercialization were drastically changed.

CONFLICTS OF INTEREST

The authors declare no conflict of financial, professional, or personal interests that may inappropriately influence the results that were obtained or the interpretations that are proposed here.

AUTHOR CONTRIBUTIONS

The two authors worked collaboratively. Thus, each one contributed 50% of the conceptualization, design, and research.

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