How Changes in Music Technology Have Impacted the Industry and Society

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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STS Research Paper

The Importance of Music

"You were the song stuck in my head. Every song that I've ever loved." There is something philosophical about this Fall Out Boy lyric in their song *Favorite Record*. The band has written a piece of music about a love whom they compare to a song, so is the song they are singing actually one of their lovers? Obviously not, but music has such a powerful emotional impact on them that they compare it to the love they feel for another person. Their experience is not an isolated event, either. Research shows that music causes the brain to release the neurotransmitters dopamine and oxytocin, which are connected to happiness and love, and reduces the stress hormone cortisol (Adler, n.d.). The oldest written song was carved into a clay tablet and has been dated to around 1400 BC in modern-day Syria, so music has stood the test of time as a staple to cultures around the world ("8 Oldest Songs in the World," 2018). Once Thomas Edison invented the phonograph, music could be recorded and shared for the first time (*The Impact of Technology on the Musical Experience*, n.d.). Since then, a whole industry has developed, and it is constantly changing as technology progresses. From the phonograph to streaming platforms, technology used in consuming and distributing a song has shifted vastly over time, and understanding this shift is critical to analyzing how music has impacted society. If a song can give someone emotions so strong that they are comparable to being in love, then understanding how music impacts society is a key revelation into both individual and group psychology. Using the actor-network theory (ANT), this paper explores how the changing technology used to consume and distribute songs has impacted both the music industry and society.

Discourse Analysis, Historical Case Studies, and Network Analysis

This paper explores how music technology has influenced the music industry and society. The three methods used for research are discourse analysis, historical case studies, and network analysis. The discourse analysis helps to describe articles, papers, blogs, etc. that identify technologies that were turning points, how they work, and how they are used. Technologies such as the phonograph or streaming platforms, serve as the historical case studies that ANT networks are framed around. Network analysis is used to take the pieces and display them as an assembled puzzle. The whole view depicts how the many actors connect in a way that makes music consumption possible and an integral part of society. Although the sources may not all be scholarly, changes in society start with the people, so looking to the general public is the best way to acquire the rawest information that was formed into a scholarly writing. This paper explores how the phonograph, streaming platforms, and social media have changed the music industry network and the effects that has had on artists and listeners in America. These technologies were chosen because they caused arguably the greatest restructuring of society at the result of their invention.

History of Music Technology

Before TikTok, streaming services, and even the phonograph, music was passed down from generation to generation orally (M. Zaccagnini, personal communication, Jan 25, 2022). The term "music technology" generally invokes imagery of computers and MIDI controllers, but perhaps the first technological advancement past oral tradition was the instrument (M. Zaccagnini, personal communication, Jan 25, 2022). Although the origin of instruments is unknown, archaeologists have discovered flutes constructed out of animal bones which are believed to be thousands of years old (*21 Musical Instruments and How They Were Invented*,

n.d.). From a societal perspective, instruments such as bells have been used in religious rituals or ceremonies for centuries (*21 Musical Instruments and How They Were Invented*, n.d.). Perhaps one of the largest revolutions in instrumentation accompanied the invention of the piano. The piano ruled in the Western world during the 19th century when it became the most popular instrument and led to sheet music being the most sold item in 19th century Europe (M. Zaccagnini, personal communication, Jan 25, 2022).

The technology surrounding the invention and standardization of sheet music encompasses another leap for music technology. One of the earliest forms of modern music notation surfaced in 1025 when Guido of Arrezo organized pitches into hexachords and developed the staff (*How Was Musical Notation Invented?*, n.d.). The previous system in place only indicated when the pitch needed raised or lowered but not by how much (*How Was Musical Notation Invented?*, n.d.). This system made it challenging for choir members in the church to learn songs, and therefore, the staff was born to give pitch clarity to the singers (*How Was Musical Notation Invented?*, n.d.). Arrezo's response to the religious need played a critical role in the formulation of modern music notation. Another major turning point occurred during the Renaissance. The invention of the printing press allowed sheet music to be more readily recorded and distributed, and sheet music became standardized once fallible human hand-copying was no longer a necessary part of its production (*History of Music Notation - Evolution, Printing, Specialisation and Computers*, n.d.).

The next major advancement in music technology came with the invention of Thomas Edison's phonograph in 1877 (*The Impact of Technology on the Musical Experience*, n.d.). This technology led to the recording of the first song: "Mary Had a Little Lamb," which substantially increased the accessibility of music from a listening standpoint (*Early Sound Recording*

Collection and Sound Recovery Project, 2012). However, perhaps the greatest transition in both music production and consumption closely follows the invention and development of the computer. Streaming services such as Spotify or Pandora made music available for free at the fingertips of anyone in possession of a smart device and internet, thus making music more mobile than ever. From a creation standpoint, software such as digital audio workstations (DAWs) or digital instruments such as synthesizers have substantially expanded the realm of possibility for composing and producing music (*How to Produce Music*, n.d.). Now, anyone with a computer can create music and upload it to the internet. The progression of music technology development has not only revolutionized the world in a technical sense but also in a societal and cultural sense that this paper explores later in the analysis.

Actor-Network Theory

The framework used to analyze this research question is Actor-Network Theory (ANT) which specializes in analyzing the different participants, or actors, in a system as well as the intricacies of how they are interconnected within that system, or the network (Cressman, 2009). With a goal set toward exploring how technology impacts society in the music industry, it is critical to examine the plethora of actors in this network to obtain a holistic view of the topic. Just a few of these actors are artists, record labels, instruments, streaming services, live musicians, and social media, which are highly diverse in attributes but still fundamental to the system in unity. Through the lens of ANT, these various actors are discussed in both how they connect to the industry and how they connect to each other. The primary strength of ANT is that the actors can be both human and non-human (Cressman, 2009). However, this is also a contributor to one of its weaknesses in that there is no differentiation in importance between human and non-human actors (*Criticism of Actor-Network Theory*, n.d.) Another criticism

toward ANT constitutes a similar idea in that there is no way to differentiate levels of importance at all when using ANT (*Criticism of Actor-Network Theory*, n.d.). However, both human and non-human actors play such a critical role in the functionality of the music industry network that considering their importance provides less insight than considering their interconnections. In other words, understanding levels of importance is significantly less revealing than understanding that there is an importance. Like pieces of a puzzle, the sizes of the puzzle pieces do not matter because the image is only complete once all the parts are in place.

Perhaps one of the biggest drawbacks of using this framework is that it does not give much insight into the passage of time (Cressman, 2009). Not considering time would be foolish in this analysis since the change of technology over time is a reason why music today is vastly different than music from the 1950s. However, the solution lies within using the framework multiple times for each era of history where a crucial technology was developed. Not only does this provide an in-depth analysis of the social impact of a technology, but it also reveals which connections between actors remain and which shift over time.

A review by Georgina Born and Andrew Barry titled *Music, Mediation Theories, and Actor-Network Theory* discusses how the use of ANT has changed when being used to analyze how mediation relates to music (Born & Barry, 2018). Specific examples of the changes along with the benefit they have brought to ANT in general are discussed in detail. For one of these examples, the article states, "Nevertheless, a focus on the contributions of technologies, media and things as 'nonhuman actors', in the terms of early ANT, runs through music research today and some of the articles that follow. It may be that the 'nonhuman actor' trope has come to act as a synecdoche for closer engagement with the evolution of ANT (and STS)" (Born & Barry, 2018). This quote discusses how nonhuman factors have come to play a role in the use of ANT

in music analysis. Although this source does not use the theory, it provides an invaluable verification on why ANT has become a viable and functional tool for the purposes of discussing music technology in an STS context (Born & Barry, 2018).

Another article titled *Putting a Glitch in the Field: Bourdieu, Actor Network Theory, and Contemporary Music* also verifies ANT as an effective tool for analyzing the music industry (Prior, 2008). This writing states that, "This is precisely the reason why the best work in actor network theory alerts us to how the technical and the social are inextricably linked, in turn sensitizing us to the fact that instruments and associated devices are not passive intermediaries but active mediators" (Prior, 2008). Similarly to the previous literature, this piece does not use ANT, but rather, validates ANT for use in an analysis of music technology. Since the research question, considering how consumption and distribution related music technology has changed and influenced society over time, has most likely not been analyzed using ANT before, this paper will attempt to fill that void in literature.

Phonograph, Streaming Platforms, and Social Media

Music technology spans centuries, which makes it challenging to analyze in its fullness; however, some technologies revolutionized the music industry. Any song not listened to from the instruments or voices directly is a downstream effect of Thomas Edison's phonograph in 1877 (*History of Music Machines | Evolution of Music Players*, n.d.). Music technology advanced slowly through the 1800s in general but exploded in the 1900s (*History of Music Machines | Evolution of Music Players*, n.d.). In the current century, streaming platforms and social media once again restructured consumption and made music more accessible than it had ever been previously. There are countless more technologies that have drastically impacted the music

industry, but the phonograph, streaming platforms, and social media created arguably the largest shifts in culture and industry advancement.

Phonograph

If a telegraph can send a message, then it should be possible to record it, right? Thomas Edison certainly believed so, and after what was most likely several hours spent grueling over such a task, Edison made this idea a reality with the invention of the phonograph (*History of the Cylinder Phonograph | History of Edison Sound Recordings | Articles and Essays | Inventing Entertainment*, n.d.). The phonograph's destiny was laid before it as Edison tested his invention by singing *Mary Had a Little Lamb* and then receiving a successful recording (*History of the Cylinder Phonograph | History of Edison Sound Recordings | Articles and Essays | Inventing Entertainment*, n.d.). The way this machine worked was by playing or speaking audio content into a horn, and the sound waves inputted would move a needle that scratches the audio into a cylinder (Magazine & Thompson, n.d.). What was supposed to be essentially an answering machine allowed music to be recorded for the first time. However, it was not particularly user friendly, and the recorded material from early iterations of the design only lasted for a few listens (*History of the Cylinder Phonograph | History of Edison Sound Recordings | Articles and Essays | Inventing Entertainment*, n.d.). The phonograph itself underwent a handful of revisions, until the cylinder was ultimately discontinued (*History of the Cylinder Phonograph | History of Edison Sound Recordings | Articles and Essays | Inventing Entertainment*, n.d.). However, the concept of a device replaying previously recorded sounds is the backbone of all music related technologies, besides perhaps the instruments themselves. Therefore, this invention is the ancestor of modern music technology.

The phonograph may have been the first in a long line of technologies, but it made a large enough impact when examined by itself at the time of its invention. By the early 1900s, the cost of this device had dropped enough so that people across a variety of socioeconomic statuses could have access to music right in their homes (Hawley, n.d.). Suddenly, music consumption became a household activity rather than a reward for spending the money and making the effort to be present with the performer (Hawley, n.d.). The impact of this device can clearly be seen when actor-network theory (ANT) is engaged. Figure 1 shows the music industry before the invention of the phonograph.

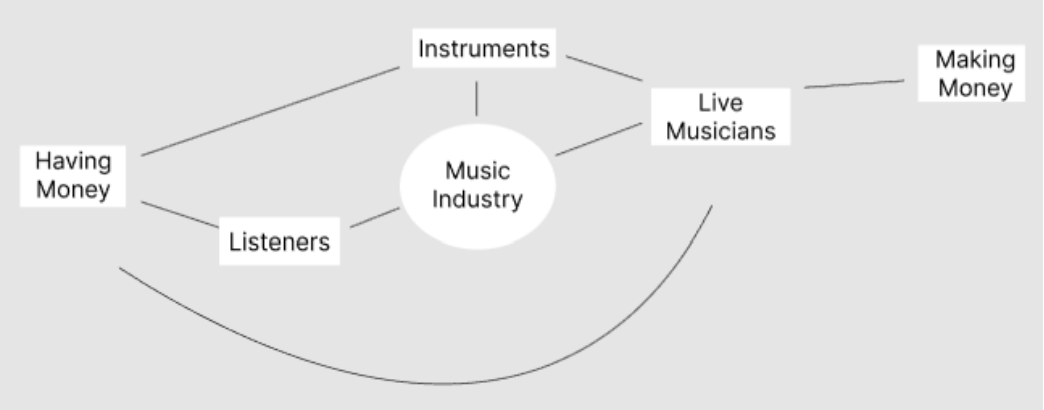

Figure 1: ANT analysis of music industry network before the appearance of the phonograph. The boxed words and phrases indicate the various actors in the network, and the lines indicate connections between the actors/network. (Kagie)

As wonderful as live music is, the monopoly that performances held due to being the only way to listen to professional music excluded those who had neither the time nor money to watch these performances (Magazine & Thompson, n.d.). According to the article "How the Phonograph Changed Music Forever," the phonograph created a new format for cash flow into the music industry. As shown in Figure 2, phonographs led to the invention of street machines in which someone could put a coin and play some type of audio.

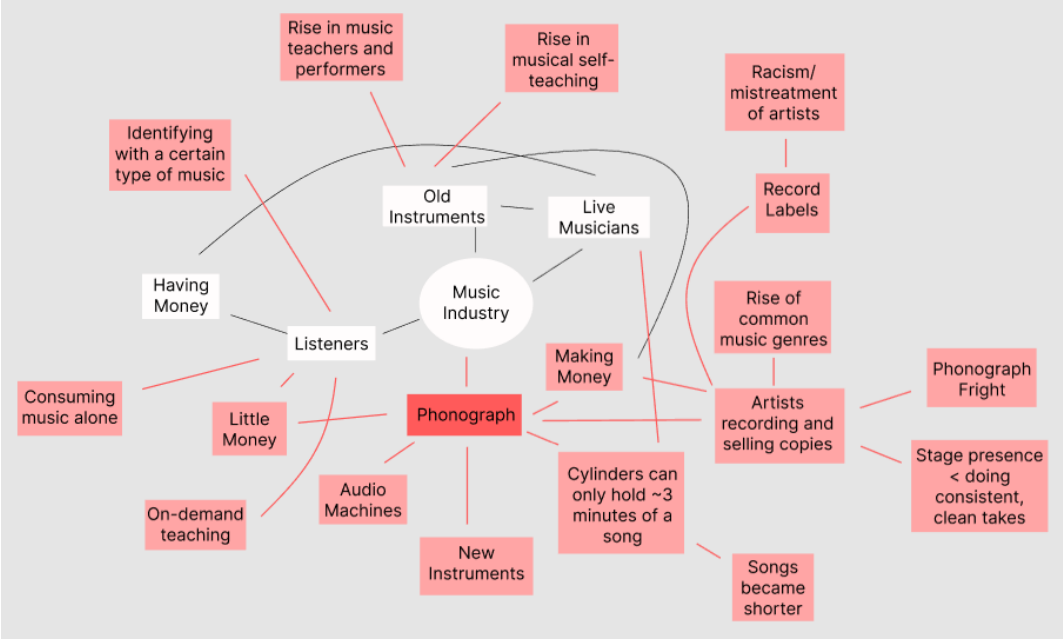

Figure 2: ANT analysis of music industry network after the appearance of the phonograph. The boxed words and phrases indicate the various actors in the network, and the lines indicate connections between the actors/network. Non-white boxes and lines indicate a change in the network due to the phonograph. (Kagie)

If people would pay to hear music on the street, would they also pay for music in their homes? Record labels and artists found the answer to this question to be a resounding yes. A new definition of the musician emerged from the machinery as artists now faced a shift in reaching people. Many experienced ‘phonograph fright’ from performing without the energy of an audience, and it was quickly discovered that being able to complete consistent, clean takes now outweighed stage presence. Without the invention of the microphone, artists were left trying to record directly to the needle, which proved to be quite difficult. New instruments were used to accommodate the low-quality recording power, and songs became significantly shorter to fit on the cylinders that could only hold about three minutes of a song. The music of the average person took on a new persona with these auditory and accessibility changes, which ultimately led to the categorization of new genres such as jazz and ‘hillbilly.’

Genres, recordings, and the easy accessibility to one's favorite song whenever desired interlaced within society as much as it did the music industry. People began to identify with their favorite genre, and consuming music alone became a new phenomenon. On a negative note, the rise of record labels increased the pandemic of racism and classism in society. Black Americans and people of lower socio-economic statuses were cheated out of fair payment for record sales, often by not receiving royalties for songs. However, the phonograph still did wonders for making music accessible and inspirational to everyone, as shown by the rise in the hiring of music teachers and performers that was observed to increase by 25%. People would also listen to tracks repeatedly to teach themselves to replicate the style (Magazine & Thompson, n.d.).

The music industry network changed substantially from the phonograph. Referring to Figure 1, there are only a few actors in this network before the phonograph: listeners with money, instruments, and performers making money. Professional music was limited and primarily for those of a higher socioeconomic status (*How Did Aristocrats Listen to Classical Music?*, n.d.). In Figure 2, the connections and actors written in pink show what changed due to the phonograph. Live music still existed, but the industry was exploding from all the new possibilities, as explained above. The phonograph caused arguably the largest shift in the overall music industry network at that point in time.

Streaming Platforms and Social Media

The industry has been revolutionized numerous times since the phonograph from inventions such as the radio, MP3 players, and DAWs, but perhaps the greatest revitalization manifested from the introduction of streaming platforms. Unfortunately, the infancy of streaming was pointing toward a dissemblance of the industry due to the rise of pirating (*The Impact of Technology on the Music Industry*, 2021). The first streaming platform, Napster, allowed users to

download songs for free which caused music revenue to plummet (*The Impact of Technology on the Music Industry*, 2021). Today, platforms such as Spotify and Pandora exist that do provide revenue to the artists, although minimal compared to past revenue from physical music sales.

By using ANT, as shown in Figure 3, the extensive network is apparent.

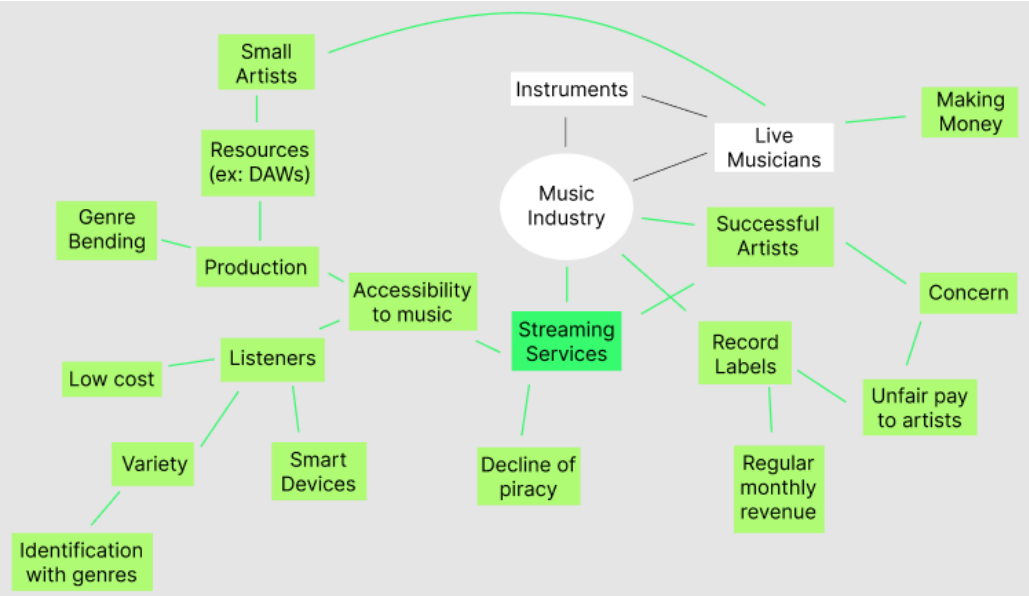

Figure 3: ANT analysis of music industry network after the appearance of the streaming services. The boxed words and phrases indicate the various actors in the network, and the lines indicate connections between the actors/network. Non-white boxes and lines indicate a change in the network due to music streaming services. (Kagie)

Clearly, there is a large time gap between streaming services and the phonograph, so the two analyses in Figures 2 and 3 cannot be easily compared. However, the actors and connections shown in green indicate changes due to streaming services. The streaming services considered are legal ones where artists receive pay for streams. To begin with the negatives, revenue from digital sales has never returned to the levels it had reached before Napster, despite streaming comprising the primary source of modern music consumption (*The Impact of Technology on the Music Industry*, 2021). To make matters worse for artists, only massively successful musicians make a decent amount of money from streams due to the criminally miniscule revenue an artist

earns per stream (Ovide, 2021). The billions of dollars of revenue that streaming platforms pour into the industry usually ends up in the hands of the record labels, which has rightfully invoked unrest among artists (Butler, 2019). Interestingly enough, musicians have reverted back to live music as their primary means of making money (Magazine & Thompson, n.d.).

Although streaming services seem overtly tragic in this light, there are a significant number of benefits that these services have brought to modern culture and the industry as a whole. From a production standpoint, the industry exploded in accessibility to aspiring artists. The resources needed to produce and upload a track are minimal and can be acquired in one's living room (Butler, 2019). Now that anyone with a smart device can upload music to the internet, the number of small artists has increased substantially, and the need for record labels has decreased (Butler, 2019). Also, artists are losing little to no money to the piracy that caused a $5.1 billion drop in revenue in 2010 (Butler, 2019). From a listener point of view, as long as someone has a smart device and internet, essentially every song is available on demand for free due to the free versions of streaming apps. Apps like YouTube or Spotify require payment in advertisement watching for those who do not want to pay with money. The result: nearly every American can listen to whatever they want wherever they want, for little to no cost. Additionally, since listeners have access to so many genres, niche genres have risen in popularity (Ovide, 2021). The increase of artistic genre exploration has led to an increase of genre exploration by the listener. Among people raised in the digital age of music, it is much more uncommon to find someone who only enjoys or identifies with one genre (Magazine & Thompson, n.d.). Spotify has even begun to organize songs by the mood they invoke regardless of genre (Parker, 2021).

The ANT analysis in Figure 3 best depicts the cultural shift experienced from streaming platforms. The fences between genres have been crossed, and listeners have ventured far beyond

the familiar pastures into new, exciting territory. Small artists have risen, and virtually anyone can upload music to the internet. True money making has resorted back to live performances for serious artists. There is a piece missing from this network; however, and that is social media. Social media itself is not exactly a platform for listening to music (excluding YouTube), but it plays such a large role in the digitization of music culture that it shares many of the connections that streaming services establish in this network. Figure 4 shows the network with social media added, and although it looks like not much has changed, social media platforms have amplified most of streaming platforms' effects. The social media specific changes are shown in blue.

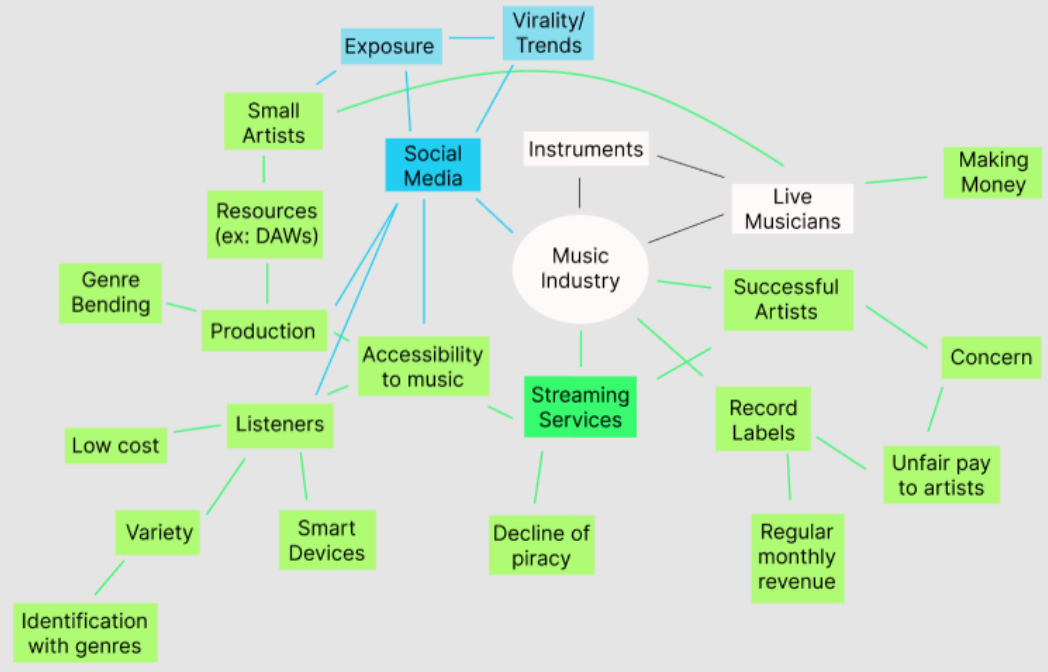

Figure 4: ANT analysis of music industry network after the appearance of both streaming services and social media. The boxed words and phrases indicate the various actors in the network, and the lines indicate connections between the actors/network. Blue boxes and lines indicate a change in the network with streaming services due to social media. (Kagie)

As a case study, the app TikTok has become so influential that songs that go viral on the app often top Billboard (*How the TikTok Boom Has Impacted the Music Industry | MI*, 2021). Anyone can use a segment of their music on the site without needing to go through a record

label, and unknown artists can become famous overnight (*How the TikTok Boom Has Impacted the Music Industry | MI*, 2021). Naturally, this means that more unknown artists are uploading onto the app, thus making it more challenging to go viral. However, the opportunity exists there for people who it likely would not have in the past. Unlike Spotify, TikTok does not alter the music presented based on listening history, so users are exposed to a wider range of genres and styles (*How the TikTok Boom Has Impacted the Music Industry | MI*, 2021). This is another key factor in how niche genres have grown, and the desire to identify with just one has declined.

One technology cannot be chosen as the most influential on the music industry because all three of the ones mentioned have changed the industry to levels that make it incomparable to how it was before the technology. A primary limitation lies within using ANT itself because it is difficult to determine which factors are more influential than others. Even though determining influence is not as important as determining connection, it could still give insight into the industry. For example, live music is present in every network, but it is difficult to express that live performances contribute to differing proportions of an artist's earnings depending on the technologies present in that time period. Additionally, this analysis is also limited in scope because a comprehensive understanding would require ANT to be performed for every influential technology, such as the radio or the iPod. However, this analysis is the first step toward understanding the whole picture, and future research is essential to filling in the gaps. Also, this paper focuses mostly on technologies relating to consumption and distribution. Focusing an analysis on technology used in composing and producing music would also provide a wholistic view on the music industry and societal results.

Music Technology and Society

The phonograph, streaming services, and social media all played major roles in shaping the music industry during their respective time periods. The phonograph reshaped the definition of a song and made music accessible to more than just the wealthy. It also facilitated the rise of recording and distribution as well as the concept of popular genres. Over 100 years later, streaming services and social media opened the possibility for nearly anyone with a smart device and internet to have cheap or even free access to every song with an existing recording. The realm of musical possibility was broadened for aspiring artists as gaining exposure and building a fanbase became easier with social media. Record labels became less influential, genres were (and are being) redefined, and artists have reverted to live music to make money. While many technologies played a role in reshaping the music industry, the phonograph was the first to popularize recorded music, and streaming services/social media accelerated music into the digital age. By understanding how music technology plays a role in shaping society, engineers will be more aware of the impacts, both positive and negative, that their devices/services may have. STS scholars will be able to better advise inventors on how the inventor's music related technology will impact society and future generations.

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