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Study the Sound of Contemporary Hit Songs

SUMMARY

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BRAȘOV, 2026

1. Introduction and Research Context

The thesis “Study the Sound of Contemporary Hit Songs” investigates the sonic characteristics of commercially successful popular music and asks how the measurable sound of hit recordings has changed across recent decades. The research combines three complementary perspectives: the historical development of popular music, the compositional characteristics of successful songs, and a large-scale technical analysis of commercially successful recordings. The central empirical component examines 120 songs drawn from the top 30 positions of the Billboard Year-End Hot 100 Singles charts for 1990, 2000, 2010, and 2020. Through this design, my research establishes a longitudinal view of how tonal balance, loudness, dynamics, and peak behaviour have changed within mainstream popular music.

The motivation for the study is closely connected to my professional background as a performer, producer, mixing and mastering engineer, and music educator. I describe a musical development that began with piano and continued primarily through guitar, followed by increasing interest in recording technology, music production, mixing, and mastering. Professional performance and recording experience, formal studies in music production and performance, postgraduate study in commercial music production, and work with artists and record labels provided practical exposure to the sonic expectations of commercial music. Teaching production and engineering techniques also contributed to my interest in identifying measurable characteristics that could explain why commercially successful recordings tend to sound the way they do.

The thesis argues that although substantial literature exists concerning music theory, songwriting, composition, and particular aspects of audio engineering, comparatively little research has systematically combined tonal balance, loudness, dynamics, and peak measurements across multiple decades of chart-leading music. The study therefore attempts to bridge practical engineering knowledge and empirical research. Instead of treating a hit song only as a composition, it treats the released recording as a technical artefact whose sound can be measured and compared.

The overall structure reflects this objective. Chapter 1 establishes the historical development of popular music. Chapter 2 examines the musical and compositional “DNA” of hit songs, including structure, melody, harmony, rhythm, vocals, production, lyrics, audience psychology, and technological context. Chapter 3 constitutes the principal original research contribution, analysing the 120 recordings quantitatively and interpreting the results through practical mixing and mastering techniques. The final conclusion brings these strands together, arguing that the

contemporary commercial sound is the result of interactions between cultural change, songwriting conventions, technological development, and evolving engineering practices.

2. Historical Development of Popular Music

The first chapter presents popular music as an evolving cultural form rather than a fixed genre. Its development is associated with technological innovation, changing modes of distribution, cultural transformation, and the continuous blending of musical traditions. Early popular music drew from folk, jazz, blues, classical music, and other traditions, while commercial accessibility, memorable melodies, catchy hooks, and relatable lyrics became important characteristics. The development of the phonograph, radio, television, records, cassette tapes, CDs, MP3s, and ultimately digital streaming progressively changed how music could be produced, distributed, and consumed.

The historical overview moves through a series of influential artists and movements. Early figures such as Bing Crosby and Frank Sinatra are presented as important in establishing vocal and popular-music traditions that preceded rock and contemporary pop. The emergence of rock and roll through artists including Bill Haley, Elvis Presley, Chuck Berry, and Little Richard transformed popular music, while The Beatles, The Rolling Stones, and Bob Dylan expanded the possibilities of songwriting, performance, and cultural influence during the British Invasion and songwriter era.

The rise of Motown and soul introduced another major dimension. Motown's highly organised production system, together with artists such as The Supremes, Diana Ross, and Marvin Gaye, demonstrated how songwriting, performance, arrangement, and production could operate together as a commercially powerful system. Disco then broadened pop's relationship with dance culture, with artists such as Donna Summer, ABBA, and the Bee Gees contributing to an increasingly international sound. Elton John is presented as an example of a superstar whose songwriting, performance, theatricality, and cross-genre appeal extended the possibilities of mainstream music.

The 1980s brought the rise of the global pop superstar. Michael Jackson and Madonna are central examples because their influence extended beyond recordings into music videos, choreography, fashion, television, and popular culture. The pop star increasingly became a multimedia identity rather than simply a recording artist. During the late 1990s and 2000s, groups such as Backstreet Boys, *NSYNC, and Spice Girls demonstrated the commercial power of highly coordinated pop production, visual branding, vocal arrangements, choreography, and memorable hooks. Artists such as Mariah Carey, Céline Dion, Britney Spears, and Justin Timberlake further illustrate the expanding relationship between vocal performance, technology, image, and global distribution.

The chapter ultimately presents pop history as a cumulative process. Each generation inherits conventions from earlier periods while modifying them through new technology, cultural influences, and audience expectations. This historical perspective is important to my thesis because the later technical measurements are not interpreted as isolated numbers: they are treated as sonic consequences of a changing production culture.

3. Contemporary Pop and the Global Music Industry

The historical discussion continues into contemporary pop, where artists increasingly operate within a global, digitally mediated environment. Beyoncé, Taylor Swift, Ariana Grande, and Ed Sheeran are presented as major representatives of contemporary popular music. Although their musical identities differ, they demonstrate a common ability to combine songwriting, genre

flexibility, production technology, visual presentation, personal branding, and direct audience engagement.

Beyoncé illustrates the integration of R&B, pop, visual storytelling, cultural themes, and large-scale performance. Taylor Swift demonstrates how an artist can transition from country to mainstream pop while maintaining a strong songwriting identity and narrative approach. Ariana Grande represents the continued importance of vocal technique while combining R&B influences with contemporary pop production. Ed Sheeran demonstrates another route to global success through songwriting, acoustic performance, digital distribution, and the conversion of relatively intimate musical ideas into highly successful commercial recordings.

The chapter also emphasises the increasing globalisation of pop. K-pop, represented by BTS and Blackpink, and artists associated with Afrobeats, reggaeton, and other regional styles demonstrate that contemporary mainstream music is no longer defined exclusively by Anglo-American traditions. Digital platforms have reduced barriers between regional scenes and global audiences. Streaming services, social media, and online video platforms enable artists to develop international audiences without relying entirely on traditional industry gatekeepers.

This technological transformation also changes audience behaviour. Music is now consumed through smartphones, earbuds, laptops, wireless speakers, cars, and other portable systems. Streaming and social-media platforms encourage music that can capture attention quickly, while platforms such as TikTok can turn short sections of songs into viral cultural objects. The thesis links these conditions to compositional priorities such as memorable hooks, concise ideas, strong rhythmic identities, and immediately recognisable sounds.

The historical chapter therefore establishes an important principle for the technical analysis: the sound of a hit song cannot be separated from the conditions in which the recording is produced and consumed. A recording from 1990 exists within a different technological and commercial environment from one released in 2020. Analogue and early digital workflows, physical media, radio, and conventional stereo systems shaped earlier releases, whereas later productions were created within digital audio workstations and distributed through streaming platforms to highly varied playback systems.

The chapter concludes that pop music survives by absorbing change. Its continued commercial dominance is not presented as evidence of a single immutable formula. Instead, its strength comes from adaptability: established conventions are repeatedly reworked through new technologies, cultural influences, genres, performers, and methods of audience interaction.

4. The Characteristics of Hit Songs

The second chapter shifts from historical development to the internal construction of successful songs. It begins from the premise that commercial success cannot be reduced to one compositional feature. Instead, successful songs tend to combine multiple elements—structure, melody, harmony, rhythm, lyrics, vocal performance, production, and emotional communication—in ways that make the overall recording accessible and memorable.

Song structure is important because it controls the listener's experience of expectation, repetition, contrast, and release. Familiar forms such as verse-chorus structures provide an accessible framework, while pre-choruses, bridges, instrumental sections, and outros can create contrast and maintain attention. I present structure as both a compositional and production tool: changes between sections often provide opportunities for dynamic, textural, harmonic, and spectral contrast.

Dynamics also contribute to the emotional architecture of a hit song. A successful recording may move from restrained verses toward larger choruses, creating a sense of development and release. The thesis repeatedly connects musical dynamics with listener psychology. Even where modern mastering reduces overall dynamic range, internal arrangement and performance can still create contrasts between sections.

Melody is treated as one of the strongest mechanisms for memorability. Successful melodies frequently use repetition, relatively simple phrases, accessible pitch movement, and recognisable contours. The discussion of Ed Sheeran's "Shape of You" illustrates how a short melodic hook can become the central identity of a recording. Stepwise movement and manageable vocal ranges can make melodies easier to sing, remember, and reproduce.

Harmony contributes emotional colour and continuity. Common chord progressions can provide familiarity while leaving enough space for melody, rhythm, lyrics, and production to carry the song's identity. I discuss the I-V-vi-IV progression as a recurring example and also gives particular attention to the supertonic or ii chord. The supertonic is described as a versatile harmonic component that can create tension while remaining compatible with the surrounding tonal environment.

Rhythm and meter provide another foundation for accessibility. Much popular music relies on a steady 4/4 meter, while syncopation, groove, off-beat accents, and stylistic rhythmic patterns introduce energy and character. The thesis uses examples such as "Uptown Funk" to demonstrate how rhythmic surprise can keep listeners engaged without sacrificing accessibility.

The combined message of this section is that successful songwriting balances familiarity and variation. Listeners need enough repetition to recognise and remember the song, but enough contrast to prevent monotony. This principle becomes especially important later when my thesis considers the industrial "track-and-hook" approach to modern commercial songwriting.

5. Vocals, Production, Lyrics, and Emotional Connection

Vocals are presented as a central identifying feature of popular music. A singer's timbre, phrasing, pitch, articulation, and emotional delivery can become as recognisable as the composition itself. The development of modern production technology has expanded the ability of engineers to edit, tune, align, layer, and spatially process vocal performances. Tools such as pitch correction and vocal-alignment software allow multiple takes and harmonies to function as a coherent production unit.

The thesis treats production as more than technical polishing. Arrangement, synthesisers, programmed drums, effects, layered instrumentation, and spatial processing all contribute to the identity of a hit. Contemporary pop production often builds dense but controlled sonic textures in which every element occupies a functional position. The example of Rihanna's "Umbrella" illustrates how multiple layers can create an immersive sonic environment while maintaining a clear central vocal and rhythmic foundation.

Vocal effects are discussed both as corrective tools and creative devices. Autotune can be used to repair pitch but can also become an intentional aesthetic. The thesis references T-Pain as a particularly influential example of treating pitch correction as a defining sonic effect. Reverb and delay similarly contribute to space, depth, and emotional character.

Lyrics are considered another major source of audience connection. Successful songs often address universal experiences such as love, heartbreak, desire, loss, empowerment, nostalgia, or escape. The use of simple language can increase accessibility, while storytelling can give a recording greater emotional depth. Metaphor, symbolism, imagery, and repetition allow songs to be memorable while leaving room for listeners to interpret them personally.

Repetition is particularly important. Repeated phrases reinforce the central message and make the song easier to remember. Call-and-response patterns, sing-along choruses, and danceable rhythmic components can also transform the listener from a passive recipient into a participant. This participatory quality helps explain why certain songs become cultural anthems rather than simply successful recordings.

The thesis also stresses articulation and performance detail. Staccato or legato delivery, vocal inflection, instrumental phrasing, and transient articulation can influence the emotional character of a recording. These micro-level decisions interact with the larger structure and production.

The overall argument is that a hit song is a multidimensional experience. Composition supplies the framework, performance supplies identity and emotion, lyrics provide narrative or thematic connection, and production turns these elements into a finished sonic object. The strongest commercial recordings therefore do not simply contain catchy melodies; they organise musical, emotional, and technical information so that listeners can recognise, understand, feel, and remember the song.

6. Case Studies of Iconic Hit Songs

The thesis uses a series of case studies to demonstrate how compositional and production principles operate in specific successful recordings. Michael Jackson's "Billie Jean" is presented as an example of how simplicity can coexist with complexity. Its recurring melodic motifs, narrow verse range, memorable bassline, tight drums, relatively simple harmony, and carefully controlled production create an immediately recognisable identity. The groove is particularly important: the bassline and rhythm section provide a physical foundation while the vocal delivery adds narrative tension.

Adele's "Rolling in the Deep" illustrates another approach. The song combines soul, blues, and pop characteristics, with restrained verses developing into powerful choruses. The I-IV-V harmonic foundation is straightforward, but the emotional impact comes from vocal intensity, rhythmic propulsion, percussion, backing vocals, and gradual arrangement growth. The production mirrors the emotional escalation of the lyrics.

The Weeknd's "Blinding Lights" demonstrates the successful revival of an earlier aesthetic through modern production. Its 1980s-inspired synthesiser textures, electronic drums, driving bass, repetitive melody, and anthemic chorus combine nostalgia with contemporary loudness and production standards. The song demonstrates that innovation does not necessarily require abandoning historical sounds; instead, older sonic conventions can be reconstructed within a modern framework.

Whitney Houston's "I Will Always Love You" represents the power of restraint and vocal performance. Sparse instrumentation leaves significant space for the vocal, while the melody expands from delicate phrases toward dramatic peaks. The simplicity of the harmonic support allows the voice to become the principal emotional instrument.

Ed Sheeran's "Shape of You" demonstrates the effectiveness of rhythmic melody, repetition, a minimalist harmonic loop, and dance-oriented percussion. Beyoncé's "Single Ladies," Billie Eilish's "bad guy," Taylor Swift's "Shake It Off," The Beatles' "Hey Jude," Prince's "Purple Rain," Beyoncé's "Formation," and Kendrick Lamar's "HUMBLE" further broaden the case-study set, illustrating that there is no single stylistic sound that defines commercial success.

The importance of the case studies is therefore comparative rather than prescriptive. Successful songs may be sparse or dense, acoustic or electronic, rhythmically simple or complex, emotionally intimate or highly anthemic. What they share is the ability to create a coherent relationship between composition, performance, production, and audience expectations.

This supports a key thesis principle: there is no universal formula that guarantees a hit. Instead, successful songs repeatedly demonstrate effective management of attention, expectation, repetition, contrast, emotional meaning, and sonic identity. The technical analysis in Chapter 3 is consequently not intended to discover a fixed recipe for success. It seeks to identify measurable territories in which successful recordings have tended to operate.

7. Audience Psychology, Technology, and Songwriting Practice

The second chapter expands beyond musical structure to consider why particular musical characteristics may appeal to audiences. Familiarity is important because repeated exposure can

increase recognition and liking. Hooks, repetition, predictable structures, and accessible melodies reduce the cognitive effort required to understand a song while allowing listeners to anticipate and participate in it. At the same time, small deviations from expectation can maintain interest and create emotional impact.

The thesis also considers emotional resonance. Songs that connect with universal experiences can become meaningful to listeners whose individual circumstances differ from those of the songwriter. A successful recording can therefore combine specific artistic expression with themes broad enough to permit personal identification.

Audience demographics and social context also influence songwriting. Contemporary music is consumed by audiences with different ages, cultural backgrounds, geographic identities, and platform preferences. Streaming has made global access normal, while younger listeners increasingly encounter music through social and short-form video platforms. These environments can reward concise, immediately memorable musical ideas.

Technological innovation is another major force. Digital audio workstations, virtual instruments, pitch correction, sampling, synthesis, editing, and advanced processing tools have made it possible to construct highly detailed recordings with enormous precision. I describe this technological development as a factor that has changed both the sound and the workflow of popular music.

The “track-and-hook” approach is presented as a particularly important modern songwriting practice. Instead of imagining songwriting as a solitary process in which one person writes an entire song from beginning to end, the contemporary commercial system can divide responsibilities among producers, top-line writers, lyricists, artists, engineers, and other specialists. The “track” establishes the instrumental foundation, after which hooks and melodies are developed, followed by lyrics.

Hooks can occur throughout the song rather than only in the chorus. Introductory motifs, verse phrases, pre-chorus ideas, instrumental signatures, and chorus melodies can all function as hooks. This increases the density of memorable information and reduces the amount of time before the listener encounters something distinctive.

The approach has been associated in my thesis with producers such as Max Martin and Denniz Pop and with Stockholm’s Cheiron Studios. Their work demonstrates how commercial songwriting can become highly collaborative, systematic, and detail-oriented without necessarily eliminating creativity.

However, my thesis also acknowledges criticism. A strong emphasis on repetition, marketability, and proven structures can produce formulaic music and may place commercial considerations above artistic experimentation. The chapter therefore maintains a balanced position: systematic songwriting practices can increase the probability of accessibility and memorability, but they cannot guarantee artistic or commercial success.

8. Research Aim and Corpus Selection

Chapter 3 begins the original empirical study. Its central purpose is to identify recurring technical characteristics in commercially successful popular music across four decades and convert those observations into useful technical reference points. The research focuses on the sound of released recordings rather than reconstructed mixes or isolated production stages.

The corpus consists of 120 recordings: the top 30 songs from the Billboard Year-End Hot 100 Singles charts for 1990, 2000, 2010, and 2020. The Year-End chart is selected because it reflects sustained commercial performance over a full calendar year rather than a short-lived weekly peak. The top-30 restriction concentrates the study on recordings with particularly high mainstream visibility while keeping the dataset manageable enough for detailed full-song analysis.

The four selected years function as historical markers. The 1990 dataset represents an era in which analogue and digital practices coexisted. By 2000, digital audio workstations had become

central to professional production. The 2010 period reflects highly mature digital production, widespread in-the-box mixing, and the continued intensification of loudness competition. The 2020 dataset represents an environment dominated by streaming and highly developed digital production techniques.

The recordings are intentionally not restricted to a single genre. Since the Billboard chart aggregates commercially successful music across stylistic categories, the dataset includes pop, rock, R&B, hip-hop, dance, and related mainstream forms. The thesis treats this diversity as useful because the objective is to describe commercial production characteristics broadly rather than establish genre-specific norms.

Only the original commercially released versions corresponding to the chart entries were included. Alternate mixes, remasters, live recordings, and remixes were excluded. The recordings were obtained legally as high-quality stereo M4A files at 44.1 kHz and 256 kbps AAC through Apple Music. Using one distribution source was intended to reduce differences caused by varying encoding and platform processing.

Each file was imported into Logic Pro using settings that preserved the source characteristics. No normalisation, equalisation, gain adjustment, compression, or other processing was applied before measurement. Track boundaries were aligned to the audible beginning and end of each recording, including attention to fade-outs. Measurements were made through offline playback from start to finish.

The methodological philosophy is therefore one of consistency and reproducibility. The released master is treated as the unit of analysis, and every track is exposed to the same measurement framework. This allows differences between decades to be interpreted as differences in the recordings themselves rather than differences caused by inconsistent analytical procedures.

9. Measurement Framework and Technical Parameters

The technical analysis combines frequency-domain observation with quantitative loudness and dynamics measurements. Tonal balance is treated separately from the numerical loudness parameters because frequency distribution is difficult to reduce meaningfully to a single number across a diverse musical corpus.

Tonal balance was analysed using iZotope's Tonal Balance Control 2 across the 20 Hz–20 kHz spectrum. Two viewing modes were used. Broad View provides a high-level representation of energy across broad frequency regions, while Fine View provides a more detailed continuous view. The analysis divides the spectrum into four regions: low frequencies from 20 Hz to 250 Hz, low-mid frequencies from 250 Hz to 2 kHz, high-mid frequencies from 2 kHz to 8 kHz, and high frequencies from 8 kHz to 20 kHz. No corrective targets or genre presets were imposed; the plugin was used for observation and visualisation.

Loudness and dynamic behaviour were measured using Youlean Loudness Meter 2 Pro, operating according to ITU-R BS.1770 principles. Six quantitative parameters were central to the analysis: integrated loudness, loudness range, average dynamics, momentary loudness maximum, short-term loudness maximum, and true peak maximum.

Integrated loudness describes the overall level of a complete recording. Loudness range provides information about the difference between relatively quiet and loud portions. Average dynamics provides another indication of dynamic behaviour. Momentary and short-term loudness maxima capture peak behaviour over different temporal windows, while true peak maximum identifies inter-sample peak levels that may exceed the nominal digital sample ceiling.

The thesis uses statistical summaries for each decade and for the combined 120-track dataset. These include minimum and maximum values, mean values, modal ranges, anti-modal ranges, and distributions across defined intervals. This allows my research to distinguish typical values from extremes and to identify where commercially successful tracks cluster.

The analysis is intentionally descriptive rather than prescriptive. A value occurring frequently among hits does not mean that producers must reproduce it. Instead, it indicates that a particular technical territory has historically been compatible with mainstream commercial success.

The methodology also includes ethical considerations. The recordings were legally purchased and used exclusively for academic analysis. No human participants or personal data were involved. The thesis emphasises transparency in corpus selection, measurement procedures, and documentation.

An important methodological strength is the full-length analysis of every recording. Rather than analysing a short excerpt, the study captures the entire dynamic and spectral behaviour of each track. This means that intros, verses, choruses, bridges, breakdowns, and outros can all contribute to the final measurements, making the dataset more representative of the actual released recording.

10. Results: The 1990 and 2000 Periods

The 1990 dataset establishes the earliest technical reference point. It includes a broad mixture of popular styles and provides a relatively wide range of loudness and dynamic behaviour. I present individual tonal-balance graphs and full-track loudness measurements for all thirty recordings, followed by statistical summaries.

The 2000 dataset represents a transitional period in which digital production had become increasingly dominant. The mean integrated loudness is reported as -9.6 LUFS, with a mean loudness range of 5.5 LU and mean average dynamics of 10.6 LU. The mean momentary loudness maximum is -5.3 LUFS, the mean short-term maximum is -6.8 LUFS, and the mean true peak maximum is 1.0 dB.

The 2000 data also show substantial variation. Integrated loudness ranges from -12.8 LUFS in “Amazed” by Lonestar to -6.8 LUFS in “He Wasn’t Man Enough” by Toni Braxton. Loudness range extends from 1.9 LU to 12.9 LU, while average dynamics extend from 7.8 LU to 14.1 LU. True peak values range from approximately 0 dB to 3.4 dB.

The modal distributions are useful because they identify where the largest number of recordings cluster. Integrated loudness most commonly falls between -8.9 and -8.0 LUFS, while average dynamics most commonly occupy the 10.0 – 10.9 LU range. The most frequent true peak interval is 0.5 – 0.9 dB. These distributions indicate that although extreme examples exist, a substantial portion of the commercial catalogue occupies a narrower central territory.

The 1990 results, by comparison, establish a more variable baseline. The thesis later identifies the 1990–2020 trajectory as one of increasing loudness and decreasing dynamic expressiveness, meaning that the earlier material contains quieter and more dynamically expansive examples that become less common in later periods.

The importance of these early datasets is not that they represent a single “1990 sound” or “2000 sound.” Rather, they demonstrate the range of technical decisions that were commercially viable before the strongest modern loudness pressures and before streaming became the dominant distribution model.

The decade-by-decade analysis also shows that commercial success has always accommodated diversity. Even within one year, songs can occupy substantially different tonal and dynamic territories. Consequently, the later combined statistics should be interpreted as descriptions of tendencies, not proof of a single production formula.

The 2000s appear particularly important as a bridge between older production practices and the more aggressively controlled sound that becomes prominent in the 2010s. Digital editing, automation, processing, and increasingly sophisticated mastering tools allowed engineers to exercise much tighter control over recordings while preserving a polished commercial presentation.

11. Results: The 2010 Period

The 2010 dataset represents a mature stage of digital commercial production. I describe the period as strongly influenced by pop-oriented aesthetics, while also containing important hip-hop and R&B material. Examples include Lady Gaga’s “Bad Romance,” Katy Perry’s “California Gurls,” Rihanna’s “Rude Boy,” Bruno Mars’s “Just the Way You Are,” Kesha’s “TiK ToK,” Eminem’s “Not Afraid,” and JAY-Z and Alicia Keys’s “Empire State of Mind.”

The mean integrated loudness for the 2010 dataset is -8.0 LUFS, which is substantially louder than the earlier period. Mean loudness range is 5.8 LU, and mean average dynamics is 9.3 LU. The mean momentary loudness maximum is -4.4 LUFS, while the mean short-term maximum is -5.5 LUFS. Mean true peak maximum reaches 1.3 dB.

The most extreme integrated loudness value is -5.7 LUFS in “Empire State of Mind,” while the lowest is -10.3 LUFS in “OMG.” Loudness range extends from 0.9 LU in “Sexy Bitch” to 14.8 LU in “Fireflies.” Average dynamics range from 7.3 LU to 11.4 LU. Momentary loudness maxima range from -6.1 LUFS to -2.7 LUFS, and true peak values extend to 2.8 dB.

The modal values demonstrate the concentration of the dataset around relatively high loudness. Eleven songs fall in the -7.9 to -7.0 LUFS integrated-loudness interval. Average dynamics most frequently occur between 8.0 and 8.9 LU, and momentary maxima most frequently occur between -3.9 and -3.0 LUFS.

The thesis interprets these results as evidence of increasingly standardised loudness practice. Compared with earlier decades, the commercial recordings are more tightly controlled, and the gap between quieter and louder material narrows. This corresponds with the broader historical discussion of the loudness war, where competitive playback impact encouraged producers and mastering engineers to reduce dynamic variation and raise average level.

At the same time, the 2010 dataset is not uniformly compressed. Some recordings retain considerable dynamic range. The wide spread of loudness-range values demonstrates that highly dynamic productions remained possible within the commercial environment.

Tonal analysis adds another dimension. The thesis identifies a gradual increase in low-frequency emphasis and a relative decline in high-mid energy over the broader four-decade dataset. The 2010s occupy an intermediate position in this trajectory. Modern bass-heavy production becomes increasingly prominent, while the use of digital tools allows engineers to maintain clarity through selective equalisation, dynamic processing, sidechain techniques, and detailed spectral control.

The 2010 period therefore serves as a key turning point: commercial production has become considerably louder and more controlled, while the sonic palette increasingly reflects digitally constructed low-end energy, dense arrangements, and precise processing.

12. Results: The 2020 Period

The 2020 dataset represents the final period and the most contemporary production environment studied. It is strongly influenced by mainstream pop and hip-hop, while also including alternative and R&B-related aesthetics. Examples include Dua Lipa’s “Don’t Start Now,” Harry Styles’s “Adore You,” Selena Gomez’s “Lose You To Love Me,” The Weeknd’s “Blinding Lights,” Billie Eilish’s “everything i wanted,” Roddy Ricch’s “The Box,” DaBaby’s “ROCKSTAR,” and Megan Thee Stallion’s “Savage.”

The mean integrated loudness is -8.8 LUFS, slightly lower than the 2010 mean of -8.0 LUFS. Mean loudness range is 6.0 LU, and mean average dynamics is 9.3 LU. The mean momentary loudness maximum is -5.1 LUFS, the mean short-term maximum is -6.5 LUFS, and mean true peak maximum is 0.5 dB.

The thesis therefore identifies a slight moderation in average loudness after the 2010 peak, but this does not represent a return to the dynamics of 1990. Instead, 2020 recordings remain substantially louder and more tightly controlled than the earliest material.

Integrated loudness in the 2020 dataset ranges from -10.5 LUFS in Trevor Daniel's "Falling" to -6.1 LUFS in Post Malone's "Circles." Loudness range extends from 2.3 LU to 11.5 LU, while average dynamics range from 6.2 LU to 10.8 LU. Momentary maxima range from -7.4 to -3.4 LUFS, short-term maxima from -8.9 to -4.0 LUFS, and true peak maxima from -0.8 to 1.4 dB.

The tonal findings are particularly significant. Low-frequency energy reaches its greatest overall prominence in the 2020 dataset, and low-mid energy is also strongest in this period. At the same time, high-mid energy is at its lowest relative level, and high-frequency energy is also lowest. The result is a contemporary commercial profile characterised by strong foundational bass and low-mid weight combined with comparatively reduced upper-spectrum emphasis.

However, my thesis repeatedly cautions against interpreting this as a uniform sound. Individual 2020 recordings differ considerably. Billie Eilish's "everything i wanted" has unusually subdued high-frequency energy, while Future's "Life Is Good" displays particularly strong low-mid content. Other tracks occupy very different spectral territories.

The 2020 results therefore demonstrate two apparently opposing developments: increased convergence around commercial loudness and production norms, and continued diversity in artistic and tonal choices. Streaming normalisation may have reduced some of the incentive for extreme loudness, but the accumulated aesthetic expectations of modern pop continue to favour dense, polished, bass-forward, highly controlled productions.

The 2020 dataset consequently provides the clearest representation of my thesis's main conclusion: the modern commercial sound is louder, denser, and more low-end-oriented than the sound of earlier decades, but successful music still occupies a surprisingly broad technical space.

13. Combined Results Across Four Decades

When the four datasets are combined, my thesis establishes a broad technical map of 120 commercially successful recordings. The combined mean integrated loudness is -9.7 LUFS, mean loudness range is 6.0 LU, and mean average dynamics is 10.5 LU. Mean momentary loudness maximum is -5.7 LUFS, mean short-term maximum is -7.1 LUFS, and mean true peak maximum is 0.8 dB.

The full range of integrated loudness extends from -16.9 LUFS to -4.2 LUFS, a 12.7 LUFS spread. Loudness range extends from 0.9 LU to 16.5 LU, producing the widest overall interval at 15.6 LU. Average dynamics extend from 4.9 LU to 16.9 LU. Momentary loudness maxima span -12.3 to -1.9 LUFS, short-term maxima span -14.1 to -3.0 LUFS, and true peak maxima extend from -1.4 to $+3.4$ dB.

The modal distributions show where the commercial centre of gravity lies. Integrated loudness most commonly occurs between -8.9 and -8.0 LUFS, encompassing 26 recordings. Loudness range most frequently occurs between 3.0 and 3.9 LU. Average dynamics most commonly occur between 10.0 and 10.9 LU. Momentary maxima cluster most strongly between -5.9 and -5.0 LUFS, while short-term maxima are most frequent between -6.9 and -6.0 LUFS. True peak maxima most commonly occur between 0.0 and 0.4 dB.

The tonal analysis reveals an equally important long-term change. Low frequencies are weakest in 1990 and strongest in 2020. Low-mid energy also reaches its maximum in 2020, although its ordering differs slightly among the earlier decades. High-mid energy follows the opposite trajectory, being strongest in 1990 and weakest in 2020. High-frequency energy is strongest in 2000 and weakest in 2020.

Taken together, these findings describe a spectral redistribution rather than a simple increase in overall level. Modern productions do not merely become louder versions of older productions. They also allocate energy differently across the spectrum. The low end has become a more

dominant component of the commercial sonic identity, while the upper midrange and high frequencies have become comparatively less prominent.

The data also reveal the importance of outliers. Extremely loud, extremely dynamic, very bass-heavy, or unusually restrained recordings all exist within the commercial corpus. This demonstrates that commercial success cannot be reduced to one numerical target.

The thesis therefore proposes the dataset as a reference framework rather than a rigid formula. The most useful conclusion is not that a mix should reach one exact LUFS value or one spectral curve, but that successful recordings historically occupy identifiable zones. Producers can use these zones to understand context while preserving artistic judgement.

14. Tonal Balance and Equalisation Practices

The discussion chapter translates the tonal results into practical engineering considerations. The central observation is that mainstream mixes have become increasingly low-frequency dominant. This can create power and physical impact, but it also creates technical challenges because excessive low-end energy can mask vocals, instruments, transients, and upper-frequency detail.

The thesis distinguishes between frequency span and frequency intensity. Some recordings occupy a broad spectral range, while others are comparatively narrow. The 2020 dataset displays the widest variation in frequency spans, whereas some 2000s recordings tend toward more uniform distributions. Individual examples demonstrate that genre expectations are useful but not absolute. A rock track may emphasise high mids, while a hip-hop recording may unexpectedly contain strong upper-frequency content.

One major engineering strategy discussed is the Pultec “two-knob trick,” in which a low-frequency band is simultaneously boosted and attenuated. Because of the interaction between the filter curves, the technique can create stronger perceived low-end weight while reducing unwanted buildup. The thesis connects this historical analogue technique with the contemporary demand for powerful but controlled bass.

Neve, API, and SSL equalisation approaches are also discussed. Neve-style EQs can provide broad tonal shaping and harmonic character, while API-style EQs can offer focused midrange control. SSL EQs provide precise management of presence, low-mid buildup, and transient-related definition. Rather than relying on one processor, engineers can distribute tonal shaping across different stages and instruments.

The thesis also discusses layering. Kick drums may receive controlled low-frequency reinforcement, while bass instruments can be shaped to remain distinct from the kick. Vocals can receive high-frequency air and presence enhancement so that they remain intelligible over a bass-heavy foundation. Mix-bus processing can then make smaller macro-level corrections.

Modern digital tools expand these possibilities. Parametric EQs, dynamic EQ, spectral processors, harmonic enhancers, and tools such as soothe-type processors can target specific frequency interactions. The underlying principle remains the same: stronger bass requires deliberate management of masking elsewhere.

The tonal findings therefore have practical consequences. A bass-forward mix is not automatically a better mix. Its success depends on whether the increased low-frequency energy remains controlled enough to preserve intelligibility, impact, and separation. The thesis argues that modern engineering has increasingly become an exercise in creating substantial low-end weight without allowing the rest of the spectrum to collapse.

This is an example of the broader contribution of the study: it does not stop after identifying that frequency balance has changed. It asks what engineers can do to reproduce the useful aspects of those trends while controlling their technical disadvantages.

15. Dynamics, Compression, and the Loudness Evolution

The loudness results form one of the clearest longitudinal findings of my thesis. Integrated loudness rises substantially from 1990 to 2010 and then decreases slightly in 2020. At the same time, average dynamic behaviour becomes more constrained. The thesis interprets this as evidence of a long-term shift toward greater loudness, density, and consistency.

Compression is central to this development. Different compressor designs produce different technical and aesthetic effects. VCA compression can provide fast and controlled transient management; FET compression can introduce aggressive character and punch; optical compression provides smoother levelling; and Variable-Mu designs can produce gentle cohesion. I present these distinctions as part of a broader engineering toolkit rather than claiming that any one compressor is responsible for the historical trend.

Serial compression and parallel compression are particularly important. Serial processing divides dynamic control across multiple stages, allowing each compressor to perform a smaller amount of work. This can produce a dense and controlled result without forcing one processor to create excessive gain reduction. Parallel compression mixes a heavily compressed signal with the original performance, increasing density and apparent energy while retaining transients and natural dynamics.

The SSL bus compressor is discussed as an example of mix-bus cohesion. Moderate ratios, relatively slow attacks, and controlled releases can tighten a mix without destroying its internal movement. Such techniques illustrate how contemporary engineers can produce a recording that feels compact and powerful while preserving some transient contrast.

Transient control becomes increasingly important as average level rises. The thesis notes that momentary peaks remain above short-term averages, meaning that even highly compressed recordings retain transient information that contributes to perceived excitement. Modern engineers therefore need to control peaks without eliminating the sense of impact.

The study also describes targeted low-frequency processing. Tools such as Ozone Low End Focus can enhance punch in kick and bass regions without indiscriminately increasing the entire spectrum. This allows modern engineers to preserve the perception of impact even when overall dynamics are constrained.

Peak management is another defining part of contemporary mastering. Clipping can reduce the highest transient peaks before a limiter is applied, lowering crest factor and allowing the average level to rise more efficiently. A limiter can then perform final peak control. High oversampling can reduce aliasing associated with clipping, making the process more transparent.

The thesis consequently presents the loudness evolution not as the result of one “loudness war” processor but as the cumulative result of increasingly sophisticated multi-stage workflows. Modern loudness is built through many small decisions: arrangement, transient shaping, compression, saturation, clipping, limiting, and harmonic enhancement.

16. Harmonic Enhancement and the Loudness Experiment

The thesis gives special attention to harmonic enhancement as a method of increasing perceived loudness without relying exclusively on compression. The Sonnox Oxford Inflator is presented as an example of a processor that can increase density and perceived level through harmonic shaping and waveform manipulation.

The importance of this approach becomes clear in my thesis’s controlled experiment. An eight-bar chorus section was taken from a completed mix and processed sequentially through several stages. The original mix measured -12.6 LUFS integrated. After transparent SSL bus compression, the result measured -12.4 LUFS, demonstrating that gentle bus compression primarily stabilised the dynamic envelope rather than dramatically increasing loudness.

The Oxford Inflator was then added. This stage raised the integrated loudness to -9.4 LUFS, a substantial increase of approximately 3 LUFS. The thesis interprets this as evidence that

harmonic density and waveform shaping can significantly affect perceived and measured loudness without functioning like conventional brickwall limiting.

Next, StandardCLIP was introduced with a -1 dB clipping threshold, soft clipping, and high oversampling. Integrated loudness increased to -8.7 LUFS. By shaving transient peaks before final limiting, the clipper reduced crest factor and created additional space for the average signal level.

Finally, Ozone 12 Maximizer was applied. The integrated loudness reached -7.0 LUFS. The complete chain therefore increased the section from -12.6 to -7.0 LUFS, a total increase of 5.6 LUFS.

The importance of this experiment lies in the staged nature of the result. No single processor is required to produce the entire loudness increase. Instead, several complementary stages contribute: bus compression creates cohesion, harmonic enhancement adds density, clipping reduces the most aggressive peaks, and limiting establishes the final level.

This mirrors the broader historical findings. If contemporary commercial masters are louder and more controlled, this does not necessarily mean that engineers simply pushed a limiter harder. Advances in processing allow loudness to be distributed across multiple stages, each contributing a smaller and more manageable change.

The thesis also notes that a large proportion of analysed recordings exceeded 0 dBFS in true peak measurements. This indicates that strict sample-peak compliance has often been less important than achieving competitive perceived loudness. The modern mastering environment therefore involves a continuing balance between loudness, transient preservation, inter-sample peak behaviour, and playback compatibility.

The experiment functions as a practical demonstration of my thesis's broader philosophy: statistical observations become more useful when translated into concrete production workflows. The research therefore connects academic measurement with the real decisions made by producers, mix engineers, and mastering engineers.

17. Comparison with Existing Research

The thesis positions its findings within a wider research tradition. Several previous studies have investigated loudness, dynamic range, perception, or compositional change, but the present study argues that its combination of sampling strategy, technical parameters, measurement tools, and production-oriented interpretation is distinctive.

Dong Ho Kwak's research on auditory loudness perception and popular music between 1980 and 2010 provides an important comparison. Kwak analysed Billboard singles at five-year intervals and found an upward trend in integrated loudness. The present thesis observes a similar historical movement, although it uses different years, a different sample structure, and a different measurement tool. Both studies therefore support the broader conclusion that mainstream recordings have become louder over time.

Max Blau's research on the "loudness war" provides another close comparison. Blau identified increasing loudness and decreasing dynamic range in recordings from the 1980s through the 2000s. His work also emphasised that loudness escalation is not purely technical: engineers, artists, labels, and consumers all participate in the cultural system that creates pressure for louder recordings. The thesis finds similar patterns in its own dataset.

Andre Stärnman's perceptual study is complementary rather than directly comparable. Stärnman investigated when listeners can detect limiting in loudness-normalised music. The thesis uses this work to distinguish measurable change from perceptual salience. A technical difference may be objectively real without being immediately noticeable to listeners.

Katrin Hermes's work on mix quality contributes a perceptual framework around clarity, separation, balance, and freedom from technical faults. The present thesis does not attempt to determine whether the tonal changes it observes make mixes better or worse. Instead, it

documents historical change. Hermes's framework nevertheless helps explain why increasing low-frequency energy could have consequences for masking and clarity.

Mark Wendl's research into loudness perception and crest factor across frequency bands is particularly relevant to my thesis's low-end findings. Wendl showed that dynamic-range compression can influence perceived loudness differently across frequency regions. This supports my thesis's interpretation that increasing low-frequency energy and reduced dynamics can combine to create a stronger perception of weight and intensity.

Finally, Beach and Claire's large-scale study of pop melodies demonstrates the value of longitudinal chart-based research. Their focus is compositional rather than technical, but the shared use of large Billboard datasets shows that systematic empirical analysis can reveal long-term changes in popular music.

The thesis's contribution is therefore best understood as complementary. It does not claim to replace previous loudness, perception, or composition studies. Instead, it combines several dimensions within one production-focused framework, extending the historical analysis of popular music into the measurable characteristics of finished recordings.

18. Originality, Limitations, and Practical Contribution

The thesis identifies several elements that distinguish its research design. First is the sampling framework: the top 30 Billboard Year-End Hot 100 recordings from four clearly separated years—1990, 2000, 2010, and 2020. This creates a longitudinal dataset with both historical breadth and strong commercial relevance.

Second is the breadth of the analytical parameter set. The study combines tonal balance, integrated loudness, loudness range, average dynamics, momentary loudness maximum, short-term loudness maximum, and true peak maximum. Earlier research has often focused on subsets of these variables, whereas my thesis places them in a unified framework.

Third is methodological consistency. All recordings were analysed with the same tools and under the same general conditions. Tonal balance was examined with Tonal Balance Control 2, while loudness and dynamics were measured using Youlean Loudness Meter 2 Pro. Full-length tracks were analysed rather than short excerpts, allowing the measurements to include complete song structures.

Fourth is the translation of measurements into practical benchmarks. The thesis does not simply report mean values. It also identifies minima, maxima, modal ranges, anti-modal ranges, and distributions. These statistics allow engineers to see not only the average commercial sound but also the breadth of technically successful alternatives.

The fifth contribution is the integration of engineering practice. The discussion of equalisation, analogue EQ characteristics, dynamic processing, harmonic enhancement, clipping, limiting, and transient control explains how the measured trends might be achieved in real production.

At the same time, my thesis makes clear that its benchmarks should not be interpreted as universal rules. Commercial success is compatible with wide technical variation. A song can succeed with comparatively low loudness, unusually wide dynamics, unusual spectral balance, or highly distinctive production choices. The dataset is therefore descriptive rather than deterministic.

The study also has natural boundaries. It examines four selected years rather than every year, and it focuses on the top 30 recordings rather than the entire Billboard chart. The analysis is based on commercially released stereo masters rather than multitrack sessions, so my research cannot determine exactly which individual production decisions created a measured result. Tonal balance is also treated primarily through visual analysis rather than reduced to a single numerical score.

Nevertheless, the practical value remains substantial. For producers and engineers, my thesis provides a contextual map. Instead of guessing what commercially successful recordings tend to

look like technically, an engineer can compare a mix against historically observed ranges. The numbers do not replace listening; they supplement it.

The thesis therefore frames technical measurement as a tool for informed decision-making rather than a substitute for artistic judgement. Its strongest practical contribution is the connection between measurable evidence and professional workflow.

19. Overall Findings and Interpretation

Across the entire thesis, several major findings emerge. The first is that commercially successful popular music has undergone a significant technical transformation since 1990. The overall direction is toward greater loudness, reduced dynamic variation, stronger low-frequency and low-mid energy, and a more controlled presentation.

The loudness trend is particularly clear. The mean integrated loudness rises from the earlier period to a peak around 2010, followed by a modest decrease in 2020. The thesis interprets this not as a reversal but as a new phase in which streaming normalisation and changing distribution practices coexist with established expectations for dense, competitive masters.

Dynamic behaviour follows a related trajectory. Later recordings generally exhibit less dynamic variation than earlier material, although individual exceptions remain. The commercial centre of gravity has moved toward a more controlled dynamic presentation.

The tonal transformation is equally important. Low frequencies are most prominent in the 2020 dataset, while high-mid energy is strongest in 1990 and weakest in 2020. This means that modern commercial production is not simply louder; it is spectrally different. Bass and low-mid information have become increasingly important to the perceived identity of mainstream music.

The thesis also highlights the prevalence of true peak values above 0 dB. This finding indicates that modern commercial production frequently prioritises perceived level and sonic impact over strict adherence to sample-peak limits. Contemporary mastering workflows therefore often rely on clipping, limiting, harmonic enhancement, and sophisticated peak management to achieve high loudness while preserving an acceptable subjective sound.

Yet the most important interpretive conclusion is that there is no single commercial formula. The 120-track dataset occupies a wide technical space. Some recordings are extremely loud, while others are relatively restrained. Some have wide dynamic ranges, while others are heavily controlled. Some emphasise bass strongly, while others maintain a broader spectral distribution.

This diversity matters because it prevents my research from becoming a simplistic recipe. The thesis does not conclude that every successful mix should target -8 LUFS, use a particular EQ curve, or maximise bass. Instead, it identifies recurring tendencies that can help engineers understand the context in which their choices operate.

The historical, compositional, and technical chapters reinforce one another. Historical changes explain why production practices evolved. Compositional analysis explains how successful songs capture attention through structure, melody, rhythm, lyrics, and hooks. Technical analysis demonstrates how these musical ideas are transformed into finished recordings through spectral shaping, dynamic control, and mastering.

The final picture is therefore multidimensional: successful pop emerges from the interaction of cultural context, songwriting, performance, technology, production, engineering, and audience behaviour.

20. Final Conclusion

The thesis concludes that the sound of contemporary hit songs is best understood as the result of long-term interaction between musical conventions, technological development, commercial expectations, and engineering practice. Popular music has continuously evolved, but its

evolution is cumulative. New sounds rarely replace everything that came before; instead, established structures and production ideas are repeatedly adapted to new technologies, audiences, and cultural contexts.

The historical chapter demonstrates this process through the development of popular music from early commercial songwriting and crooning, through rock and roll, Motown, disco, global pop stardom, digital-era pop, and the increasingly global contemporary industry. Artists and producers continually redefine the boundaries of what can function as mainstream music.

The compositional chapter shows that hit songs commonly use recognisable structures, memorable hooks, repetition, accessible melodies, emotionally effective harmony, strong rhythmic identities, relatable lyrics, and polished vocal production. However, successful songs do not follow a rigid formula. Their effectiveness comes from balancing familiarity with novelty and from aligning musical choices with emotional and cultural meaning.

The technical study provides my thesis's central empirical contribution. By analysing 120 Billboard Year-End Hot 100 recordings from 1990, 2000, 2010, and 2020, my research establishes a measurable history of commercial production. Across the full dataset, integrated loudness ranges from -16.9 to -4.2 LUFS, loudness range from 0.9 to 16.5 LU, average dynamics from 4.9 to 16.9 LU, momentary maxima from -12.3 to -1.9 LUFS, short-term maxima from -14.1 to -3.0 LUFS, and true peak maxima from -1.4 to $+3.4$ dB.

The long-term pattern is clear: mainstream music has become louder and denser, with stronger low-frequency and low-mid emphasis and comparatively reduced dynamic contrast. At the same time, the 120 recordings demonstrate substantial diversity, proving that commercial success remains compatible with very different sonic philosophies.

The practical conclusion is equally important. The thesis's measurements should be treated as reference zones rather than rules. Producers and engineers can use my findings to contextualise their decisions, but listening, musical intention, arrangement, performance, and artistic identity remain essential. The purpose of technical analysis is not to make every song sound identical; it is to make technical choices more informed.

Ultimately, my research bridges scholarship and professional practice. It converts the sound of commercially successful recordings into a structured set of measurable observations while connecting those observations to real production techniques such as EQ, compression, parallel processing, saturation, clipping, limiting, and harmonic enhancement. The thesis therefore contributes both a historical account of changing commercial sound and a practical framework for understanding contemporary production.

Its broader implication is that the "sound of a hit" is never purely musical or purely technical. It is produced where composition, performance, technology, engineering, industry, culture, and audience expectation meet. The contemporary hit song is consequently not defined by one sound, but by a continually evolving set of relationships between these factors.