

The Interplay of Technical and Artistic Aspects in Contemporary Music Production

Međudjelovanje tehničkih i umjetničkih aspekata u suvremenoj glazbenoj produkciji

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Abstract: *In this paper, the authors first define contemporary music production (CMP) and describe it through the standard and hybrid production chains. The standard chain consists of the recording, editing, mixing, and mastering phases. The hybrid chain adds to these phases the preparation of sounds, additional composing and arranging, and MIDI (Musical Instrument Digital Interface) programming and composing. Today, the stages of these chains are mainly realized in Digital Audio Workstations (DAWs). To implement the abovementioned phases, music producers use the following general technical aids: multitrack recording, MIDI programming, recording and editing, and modern DAW capabilities. Each technical aid can contribute to the CMP process and ease the needed work for musicians and producers. However, they are also a potential source of diminution of the achieved artistic level and expression. In certain music genres, some of these aids may be unacceptable—like the MIDI performance and recording in classical or jazz music. These aids, together with their advantages and disadvantages, are summarized in a table. Additionally, the authors present and discuss examples of the several CMPs they have actively participated in. They deliberate the technical aids used and the artistic level achieved regarding the genre of the musical pieces, among which there are many student works. The general conclusion is that—particularly today—the contributions of proficient (human) musicians and their good live performances greatly enhance the attained artistry of the final soundtracks. Even in the modern pop and electro genres, where the usage of MIDI and advanced DAW technologies is omnipresent, it is desirable to spice and enrich music production with audio recordings of various humanly performed musical lines.*

Keywords: *contemporary music production, music production chains: standard and hybrid, technical aids in music production, artistic aspects of music production*

Sažetak: *U ovom radu autori najprije definiraju suvremenu glazbenu produkciju (CMP, od engl. Contemporary Music Production) te je opisuju preko standardnog i hibridnog produkcijskog lanca. Standardni lanac sastoji se od faza snimanja, uređivanja, miješanja i završne obradbe (engl. mastering). Hibridni lanac tim fazama pridodaje pripremu zvukova, dodatno komponiranje i aranžiranje te MIDI (od engl. Musical Instrument Digital Interface) programiranje i komponiranje. Danas se sve te etape navedenih lanaca ostvaruju u digitalnim audio-radnim stanicama (DAWs, od engl. Digital Audio Workstations). Za realizaciju navedenih faza glazbeni producenti koriste sljedeća pomoćna tehnička sredstva: višekanalno snimanje, MIDI programiranje, snimanje i uređivanje, te suvremene mogućnosti DAW-a. Svako od tih sredstava može doprinijeti CMP procesu i olakšati posao glazbenicima i producentima. S*

druge strane, ta su sredstva potencijalni izvor smanjenja postignute umjetničke razine i izražajnosti. U određenim glazbenim žanrovima neka od njih mogu biti i neprihvatljiva—kao što je npr. MIDI izvedba i snimanje u klasičnoj ili jazz glazbi. Ta su pomoćna sredstva te njihove prednosti i mane skupljene u tablici. Autori predstavljaju i diskutiraju primjere CMP-a u kojima su aktivno sudjelovali, među kojima je i veći broj studentskih radova. Za te primjere razmatraju uporabljena tehnička pomoćna sredstva i dosegnutu umjetničku razinu s obzirom na njihov glazbeni žanr. Općeniti je zaključak da—posebice danas—doprinosi vještih (ljudskih) glazbenika i njihove žive izvedbe uvelike pojačavaju umjetnički dojam konačne snimke. Čak i u modernim pop- i elektro-žanrovima, u kojima je uporaba MIDI i naprednih DAW tehnologija sveprisutna, poželjno je glazbenu produkciju začiniti i obogatiti audio-snimkama humane izvedbe različitih glazbenih dionica.

Ključne riječi: *suvremena glazbena produkcija, glazbeno-produkcijski lanci: standardni i hibridni, tehnička pomoćna sredstva u glazbenoj produkciji, umjetnički aspekti glazbene produkcije*

1. Introduction

In modern times, recorded music of all sorts surrounds us everywhere. Contemporary music production is highly influenced by the available technology, which is nowadays typically of a digital nature. This technology also alters the way music is composed and arranged, as well as the way it is produced. At the same time, music itself has been changing, and some of the changes are direct consequences of the technology used in its creation.

In this paper, we investigate the interplay of the technology used and the achieved artistic level of the final product. We try to give the answers to the question of how musical artistry could be emphasized, possibly improved, or at least not hindered by modern technical aids. Namely, the constant technological improvements and now even announcements of the use of artificial intelligence in making music raise many questions. Should not this process be and stay an “artistic” and humanly directed activity in its essence? Stated the other way around—and this is the primary motivation for this paper—the music authors, musicians, and producers should decide what must stay humane in their work, what can be supported by the technical aids, and, finally, when the technological means become counterproductive from the artistic point of view. Of course, there will be no strict rules and no bans! The artists and music producers will have to make these decisions themselves, and the listening audience will “judge” their work by liking or disliking it more or less.

This subjectivity in the overall approach and the fact that artistry cannot be strictly defined might be why there are not many publications on this particular topic. Some articles address other music technology-related themes; e.g., see (Kramer, 1995 on) and (Yellowbrick, 2023). However, we will show that true artistry can be easily recognized without going into much detail. We shall address the above-stated questions in the next sections as follows:

In section 2, we define contemporary music production and its main features through the notions of the standard and the hybrid music chain. The particular phases of these chains are executed by technical aids of modern music technology, which changed the way the music was recorded and performed. In section 3, we discuss how these technical aids influenced the artistic aspects of the music produced, including the achieved artistic level, and how the technological solutions could be used creatively. Section 4 presents and analyzes examples of the music productions governed or supervised by the authors of this paper, which include several musical pieces produced by the students of the contemporary music production course. Finally, section 5 summarizes our findings and concludes the article.

2. Contemporary Music Production

This section defines the notion of music production in general. First, it distinguishes between the notions of music production in classical and popular music. Then, for the latter, it defines the production chains and briefly outlines their use.

Contemporary music production, which we shall abbreviate as CMP, is the human and technical process of preparing and recording or storing musical content on some *medium*, with the aim of possible repeatable reproduction of such content in the future. As such, it differs from the notion of *music production* in classical music, where it denotes a live performance of musical pieces by various performers—from solo artists and chamber ensembles to symphonic orchestras—performed in front of a live audience.

As defined here, the main task of the CMP is independent of the music genre it produces. It applies equally to the numerous popular music genres and the just-mentioned classical music. However, although the task of the CMP is the same in all music genres, how it will be accomplished significantly differs for different types of music. In the CMP of *classical, folk, and jazz music* (CFJM for short), the tendency will be to capture the authentic sound of (acoustic) musical instruments and the ambience of classical music halls. On the other hand, for *pop, rock, and similar music* (PRSM), using many technical aids in all production phases is a standard procedure today and sometimes even a must to achieve specific musical effects. In pop music, technical aids are intensively used even earlier—from the composing and arranging stages. Nowadays, classical and other composers use similar sophisticated aids in their composing and arranging, too. In general, the use of technical aids highly depends on how these aids will affect the production process and influence the artistic aspects of the final piece of music.

2.1 Music production—from classical to contemporary

When recording classical music, the producers will organize the recording sessions in a way that resembles “classical” music production as much as possible—perhaps even in front of an audience. They will take special care that the technical aspects of their production do not interfere with and do not diminish the artistic performance of musicians who play an already fully definite piece of music. On the other hand, modern music highly depends on the technical possibilities of the production technology right from the start.

Nowadays, the CMP is usually organized and performed in some kind of *digital audio workstation*, abbreviated as DAW. From the user’s perspective, DAWs are primarily identified as specialized pieces of software run on a computer, usually with good or elevated performance. To fulfill its purpose, DAW also needs audio hardware with a digital interface that is connectable to the computer (Wkp. DAW). The audio hardware can be anything from the *integrated sound card*, installed on the computer motherboard near the main chipset, up to the specialized sound cards with professional audio inputs and outputs and connected to the computer parallel or serial digital interfaces (Wkp. Sound card). Modern DAWs can functionally fully replace the need for even the most elaborate and costly analog audio consoles and recording equipment. In many features, they even significantly surpass them, although, regarding the sonic nuances, they may be inferior to the top analog equipment.

On the other hand, the primary purpose and task of “contemporary” music production did not change from the times when it was done in huge studios with big analog mixing consoles, 24-track reel-to-reel tape recorders, and numerous other stand-alone analog and digital audio devices. The main aim is to obtain the best possible final audio product of the required musical piece, according to the norms of the specific musical genre.

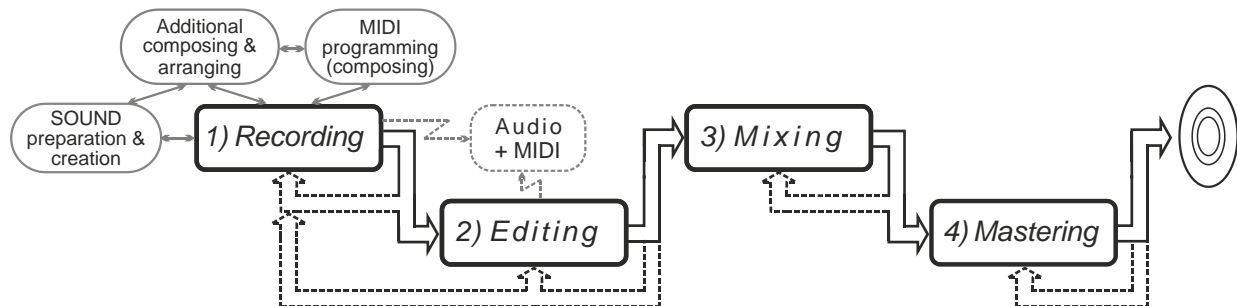
2.2 Standard Music-Production Chain

With the advancement of electronic audio devices and especially the recording equipment in the mid-20th century, the series of actions used in music production defined a procedure that we shall call the *standard music-production chain* (SMPC), or *standard chain*, for short. Its application is independent of the type of audio equipment used. It has been used on the legacy analog audio equipment and can be as well used on modern DAWs.

The standard music-production chain consists of the following four phases, which we have sketched in Figure 1:

- 1) **Recording** of the already composed and arranged audio material in one or more music tracks, all at once, or track after track, taking into account the following observations:
 - a) For the stereo recording, at least two tracks should be recorded.
 - b) With the improvement of analog recording devices, the number of tracks on the multitrack recorders increased significantly; first from 2 to 4 and 8, then up to 16, and finally up to the last industry standard, the tape recorders with 24 tracks and the 2-inch magnetic tape. Usually, not more than two such recorders were synchronized. Direct-to-disk digital recorders within DAWs can record many more or even an “arbitrary number” of tracks, limited only by the capacity of the used computer.
- 2) **Editing** of the recorded (multiple) individual audio tracks either:
 - a) In real-time, during the recording phase (number 1), or
 - b) afterward, which became especially practical and easy to perform with the introduction of the direct-to-disk digital recording organized within DAWs.
- 3) **Mixing** of the recorded individual audio tracks into some suitable audio format, which includes their prior: i) audio-frequency equalization, ii) nonlinear processing (compressing, limiting, gating side-chaining), and iii) adding of various effects (reverberations, delays, choruses, etc.). After such treatment, the individual tracks are mixed together with suitable mutual volume levels and panoramic positions in the stereo field that can also vary in time. The chosen final audio “format” can be:
 - a) *stereo audio*, as the longstanding and unsurpassed standard, with separate left and right channels (stereo audio can be easily mixed into *mono audio*, with only one channel);
 - b) *surround audio*, which—besides the two main, left and right channels—has the extra, *surround channels*. From the musical standpoint, the stereo image of the left and right channels remains the most important for the overall sound of this type of audio, too.
- 4) **Mastering** of the mixed audio includes frequency equalization, nonlinear dynamic processing (compressing and limiting), and the treatment—possibly enhancement—of the stereo audio image of the mixed audio recording. It can, although rarely, include adding some effects, like reverberation, chorus, etc. There are two primary purposes of mastering:
 - a) For an individual piece of music, like a single song or a classical music movement, the aim is to achieve that the recording sounds correct and “professionally made,” which means that its audio frequency spectrum is well equalized and is heard well on different audio reproduction devices. The individual audio product must be appropriately loud, expressive, and appealing according to the music-production standards of the particular genre.
 - b) For the series of musical pieces, like a musical album consisting of several songs or a classical piece of music consisting of several movements and other parts—the aim is to achieve the appropriate relative volume and balance of other sound elements among the individual music pieces. The final complex audio product must have the right audio appeal that contributes to the artistic impression of the whole musical product.

Figure 1. Schematical presentation of the standard and hybrid music production chains. The standard music production chain (SMPC) consists of four phases written in bolded rectangles: 1) recording, 2) editing, 3) mixing, and 4) mastering). In the hybrid music production chain (HMPC), the recording and editing phases of SMPC are appended by the additional actions shown in ellipses. Those were largely enhanced by the introduction of MIDI.



The above phases of the standard chain are commonly accomplished “linearly,” one after the other, from phase 1) to phase 4). This classic order is especially proper for classical, jazz, and folk music, performed by ensembles with many musicians. If, for instance, phase 1) is not satisfactory, all ensemble musicians should repeat it—not only those whose performance was bad. However, if the recording was done on multiple tracks, the multitrack recording technology allows only the musician(s) or music sections that did not perform satisfactorily to repeat their parts. They can do the repetition in whole or—by using the punch-in and punch-out recording techniques—in parts, rerecording only the weak portions of the musical lines. This rerecording may also be initiated in phase 2), while editing the recorded tracks after their careful listening and examination.

Introducing the multitrack recording enabled a new approach to music production, especially for the contemporary pop music genres. Namely, if it was financially affordable, phase 1) of the standard chain could be used creatively to compose and arrange the musical pieces. The artist could use the studio facilities and multitrack recording to finish their musical sketches or even start their music from scratch, combining this process with searching for the best musical solutions and the “right sound,” and even inventing new musical effects.

All of the above four stages of music production are rather complex and require a thorough knowledge of general audio engineering as well as a specialization and a lot of practical experience in each of the separate skills (Ballou, 2015). Nowadays, we find audio *recording engineers*, *audio editors*, *audio mixing* and *mastering* engineers. They should not be only technicians and engineers but also artists who can creatively contribute to the musical impression of the final audio product. To study that in more detail, we direct an interested reader to the following references: (White, 2003-1; White, 2003-2; White, 2003-3; Gibson, 1997; Katz, 2002).

Some authors consider phases 3) and 4)—and even phase 2) if done afterward—to be the *postproduction* phases of music production (Wkp. Audio post production). In our treatise on the subject, music production cannot be reduced to just the recording process. One cannot separate the editing of the recorded material from the recording itself because the two—as suggested in Figure 1—may and do intertwine very often. Furthermore, the mixing phase defines the core *sound image* and the sonic impression of the produced musical piece. Because of that, mixing is an inevitable part of both standard and hybrid music production chains.

As for phase 4), the mastering, it is often regarded as the *music* or *audio postproduction*. This is especially so if the musical piece is to be a part of some other art form, such as video or film, to which it must adapt.

2.3 Hybrid Music-Production Chain

The additional support for the integration of composing and arranging into the process of music production and for making this process less rigid and more demand-driven was the invention and immediate vast use of MIDI (*Musical Instrument Digital Interface*) (Wkp. MIDI). It enabled the usage of musical sequencers and, later on, the introduction of music composing and arranging software. All this led to a new music production paradigm, which we will call the *hybrid music-production chain* (HMPC) or, for short, the *hybrid chain*. In it, there is a fusion of what was earlier considered a part of the sole musical domain—like composing, arranging, and performing—with the aforementioned standard production chain.

The new, or at least the more explicated phases that have appeared in this chain in addition to the four phases of the standard chain are as follows (cf. Figure 1):

- 0) **Preparation and creation of sounds and sound effects.** The sound preparation includes patching or programming electronic synthesizers and using digital samplers to sample different sound sources, starting from the acoustic, electric, and electronic musical instruments, including the (analog) synthesizers mentioned above, and ending with musically interesting natural sounds. This phase is optional and may be skipped if all needed sounds are already prepared and available. Also, one can combine this phase for several musical pieces (songs) of similar genres and styles. Another solution could be to rely on the ready-made sounds available on the musical market.
- I) **Additional composing and arranging.** This was possible with the aid of multitrack recording and especially with the aid of MIDI, which enabled even the initial composing and arranging by either MIDI programming or direct MIDI recording. Several music parts, starting from the drums and bass, as well as other accompanying and even solo music parts, could be composed in and performed by musical sequencers and rhythm machines. Nowadays, this is mainly done in the dedicated musical host programs that offer all these functionalities in themselves and present the core of the DAWs. They enable precise recording of the MIDI protocol events (note-on, note-off, key-velocity, after-touch, modulation, etc.) within the musical bars or other time frames. Those MIDI events trigger the outer musical synthesizers or—today, more and more the case—the DAW's internally available plugin musical instruments, originating from either the DAW itself or some third-party manufacturers of the DSP musical products (cf. Table 1 heading).
- II) **MIDI recording and editing of the musical performance.** To obtain more realistic MIDI recordings the artist can—instead of MIDI programming—produce the MIDI tracks by playing dedicated MIDI controllers and recording the MIDI events they produce. Those controllers are mainly in the form of MIDI-enabled *master keyboards*, as well as MIDI-enabled percussion instruments, guitars, and wind instruments. The rationale for making a MIDI instead of the audio recording [phase 1) in the standard chain] could be that they are easier to change, correct, and improve, i.e., edit in general [phase 2) in the standard chain]. For instance, one can easily change the sound or musical instrument the MIDI notes trigger, transpose those notes, change the tempo of the song or some of its parts, and add expressivity to those notes by applying different modulations. Additionally, one can use MIDI to trigger and control the playing of audio samples of the whole music parts, usually lasting 2, 4, or 8 bars, called *audio* or *sound loops*. The most frequently used loops are drum loops because the rhythm patterns are generally repetitive.

The flexibility of MIDI-recorded parts, as well as many possibilities of editing and changing the audio-recorded parts in the modern DAWs, make the hybrid music-production chain very flexible and adjustable to the needs of musicians and music producers alike. On the other

hand—as we will discuss it soon—this may not be suitable for some music genres because the natural artistic impression could either not be appropriately achieved by the MIDI programming or could be lost in the MIDI recording, especially after extensive MIDI editing.

3. The Influence of Technical Aids on Music Artistic Aspects

In the last two subsections of the previous section (§2.2, §2.3), we have already hinted at several well-known technical advancements in the CMP process that can help musicians to complete and possibly improve their performance up to the desired, “professional” level. However, as with most things, this is a double-edged sword. The technical aids may diminish the continuity, expressivity, and naturalness of musical performance. They can also contribute to the loss of musical “groove” and concord between different music lines and lead to the general lack of the “human touch” in the produced music.

Table 1 summarizes the advantages and disadvantages and gives some additional comments on the technical aids available in the CMP. Most of those are self-evident, but we will discuss them a bit more in the following subsections.

3.1 The Influence of Multitrack Recording

While multitrack recording became a standard recording technique for PRSM genres, in CFJM, it may be considered unnecessary and an “overproduction.” Namely, even if there are several microphones for several instruments of a classical ensemble, one can immediately mix these multiple signals to the stereo audio in a mixing console to which they are fed. This solution is common in the live broadcasting or recording of classical, folk, or jazz concerts, often accompanied by video shooting. On the other hand, if all the microphone signals—including those for the ambient reverberations—are recorded on separate tracks, the multitrack recording allows for more precise and elaborate mixing of those audio tracks later on. Such an approach is a longstanding standard for live recordings of PRSM concerts. It can also be useful and justified for concerts of the CFJM genres. However, for them, the mixing process should be as unobtrusive as possible, with the main function to resemble the sound and ambience of the original musical performance (cf. Table 1).

In contrast to implementing the basic idea of multitrack recording—which is to have separate recordings of the individual music lines—how this procedure is done varies significantly among different music genres. In CFJM, using the separate, track-by-track recording and the punch-in-punch-out technique would be unacceptable. In PRSM genres, this is not only acceptable but is also the most common organization of the recording process. Some rock and other ensembles may insist on performing together to get the majority of tracks and then rerecord or apply the punch-in-punch-out technique of only the tracks that require corrections. Another approach would be to record together an *info track* to get the feeling of union and a good sense of the tempo and its changes. After that, each instrument can be rerecorded, ensuring a flawless performance (cf. point 1.1 in Table 1).

By insisting on collective playing in CFJM, one emphasizes the need for high artistry of musical performance and discards the help provided by the technical aids that could diminish or alter this high artistry in any way. Because of that, the ensembles must play the already-defined musical pieces together. All ensemble members must be well-prepared in all the nuances of their performance. In these music genres, it would be considered cheating if the recording process deviates from how musicians perform their concerts on stage.

Table 1. *Technical aids in contemporary music production (CMP), their advantages, disadvantages, and additional comments regarding their influence on the artistic music aspects. (Used abbreviations: CFJM = Classical, Folk, and Jazz Music, PRSM = Pop, Rock, and Similar Music, DSP = Digital Signal Processing, EQ = equalizing/equalizer.)*

<i>Technical aid (advancement)</i>	<i>Possibilities and advantages</i>	<i>Possible disadvantages</i>	<i>Additional comments</i>
1. Multitrack recording	<ul style="list-style-type: none"> Recording of musical lines on separate, individual tracks. 	<ul style="list-style-type: none"> Technical complications that might lead to the loss of the original musical coherence. 	<ul style="list-style-type: none"> Standard for PRSM. May be considered unnecessary and as “over production” in CFJM.
1.1 Track-by-track or instrument-by-instrument recording, one at a time.	<ul style="list-style-type: none"> Independent recording of individual instruments. Repetitions needed only for the lines with errors. One musician can record several music lines. Creative use for additional compos. and arrang. 	<ul style="list-style-type: none"> Deviations from the specifics of the music genre. Loss of the ensemble feeling, which can degrade the final product. Problems with correct tempo changes, directed by (absent) soloists. 	<ul style="list-style-type: none"> Standard for PRSM, but usually not acceptable for CFJM. For better ensemble feeling and correct tempo changes, prerecord an “info” soundtrack of the whole ensemble.
1.2 Punch-in–punch-out technique, usually only with 1.1.	<ul style="list-style-type: none"> Selective corrections of only the bad parts. Improvement of the performance quality. Shorter recording phase. 	<ul style="list-style-type: none"> Loss of the natural flow of performance and the musical continuity. 	<ul style="list-style-type: none"> Standard for PRSM. Not acceptable in CFJM and where virtuosity is expected—can be considered as cheating.
1.3 Elaborate editing	<ul style="list-style-type: none"> The existence of several tracks enables elaborate editing of individual ones, like silencing the unwanted signals (see point 3.1). 	<ul style="list-style-type: none"> Technical “perfection” might lead to the sterility and phoniness of the recordings. 	<ul style="list-style-type: none"> As above for 1.1.
1.4 Elaborate and creative mixing	<ul style="list-style-type: none"> Postpone the creation of the final sound image to the mixing phase. Makes mixing a fully creative and artistic process. 	<ul style="list-style-type: none"> Could change the original sound and ambience in the live music production. Leaving the errors from the previous phases to be corrected “in the mix.” 	<ul style="list-style-type: none"> Standard in PRSM and related genres, even for live concerts. In CFJM, it should reproduce the original sound and ambience.
2. MIDI	<ul style="list-style-type: none"> Great aid in musical performance: corrections and changes of instruments. 	<ul style="list-style-type: none"> Loss of naturalness, expressiveness, and overall musicality. 	<ul style="list-style-type: none"> Considered unacceptable in some genres, such as CFJM, rock.
2.1 MIDI programming	<ul style="list-style-type: none"> Precise reproduction of the musical parts, down to the accuracy of MIDI resolution. Playing the musical parts and sequences in the machine (robotic) style. 	<ul style="list-style-type: none"> Musically inadequate performance, with wrong expressivity, groove, etc. Tendency to repetition. To achieve the desired results may be time-consuming and elaborate. 	<ul style="list-style-type: none"> Standard in pop and related genres (disco, dance, funk, hip-hop). Can be considered “cheating” in rock. As the second point in 1.2, above.
2.2 MIDI recording	<ul style="list-style-type: none"> Can capture the musicality and expression of the human performance while still enabling MIDI edits. 	<ul style="list-style-type: none"> Some of the musical nuances could be lost, also because of the seriality of MIDI protocol. 	<ul style="list-style-type: none"> Could lead to satisfactory results even without superb players and with less rehearsal time.

Technical aid (advancement)	Possibilities and advantages	Possible disadvantages	Additional comments
2.3 MIDI editing	<ul style="list-style-type: none"> • Corrections and straightening of bad playing. • Later changes in arrangements and sound, the addition of musical nuances and expressivity. 	<ul style="list-style-type: none"> • Over-polishing of the played notes, e.g., over-quantizing and similar. • Postponing the completion of composition. • As above for 1.2 and 1.3. 	<ul style="list-style-type: none"> • Easy MIDI editing can diminish the need for actual playing and practicing, which can lead to artificial and unmusical parts and even styles.
3. DAW	<ul style="list-style-type: none"> • As above, in points 1 & 2. 	<ul style="list-style-type: none"> • As above, in pts. 1 & 2. 	<ul style="list-style-type: none"> • As above, in pts. 1 & 2.
3.1 DAW multitrack audio	<ul style="list-style-type: none"> • Enhanced multitrack recording, with multi-trial possibilities (automatic punch-in and punch-out). • Enhanced DSP editing capabilities (see additional comments), which can be used creatively. • Fully automated mixing with time-variable EQs, dynamics, and effect settings. 	<ul style="list-style-type: none"> • “Overproduction” for the music genres where this is not needed or desirable (as in CFJM). • Sterility and artificiality of the over-edited parts. • With pitch correction and other editing capabilities, can anybody be a singer? • Tendency to repetitiveness. • As above, in pts. 1.1–1.4. 	<ul style="list-style-type: none"> • Enhanced DSP includes: <ul style="list-style-type: none"> ◦ precise and easy position manipulation, ◦ part copying and multiplying, ◦ elaborate dynamic (volume) changes, ◦ pitch correction, etc.
3.2 DAW additional MIDI tools	<ul style="list-style-type: none"> • Graphical tools for easier MIDI programming of notes, additional MIDI events (expression parameters), and tempos. 	<ul style="list-style-type: none"> • As above, in pts. 2.1 to 2.3. 	<ul style="list-style-type: none"> • As above, in pts. 2.1 to 2.3.

3.2 The Influence of MIDI

The pros and cons of using MIDI are briefly and systematically outlined in the second part of Table 1. As expected, a proficient classical, folk, and jazz (CFJ) keyboardist or drummer/percussionist would typically not reach for the help of MIDI technology. This may be true even for other genres, especially rock. Producers and musicians may be reluctant to use MIDI because it does not record the actual sound played by the players. It can miss the true performance no matter how good the synthetic sounds are, how fine the MIDI timing resolution is, and how precise the velocity and expression sensors may be.

On the other hand, in pop, disco, dance, funk, hip-hop, and even R&B, the use of MIDI is regular, starting from the composing and arranging phase and then later in playing several musical lines, especially those less expressive and which are not the leading ones. Or, if the leading lines are recorded as MIDI, the experience shows that they should not be over-edited, if edited at all, because this technical process can highly influence (decrease) the authenticity and vividness of what was really played by good musicians.

Among the drawbacks of MIDI programming or recording and the accompanying (over)editing are the possible exaggerated uniformity, repetitiveness, and consequential boredom of the whole musical piece, especially if the music parts created this way are excessively copied. In some music genres, like techno and hip-hop, repetitiveness has become the standard feature of the style. Still, the repeating parts should be continuously appended by new musical elements to increase the overall artistic content and impression.

Today, one can buy the already programmed MIDI parts of the standard rhythm patterns for different music genres. The same is valid for the sound loops, already mentioned in the description of phase II) in §2.3. They are professionally played, recorded, and produced music parts, especially suitable for the drum and percussion lines. The use of sound loops can be considered a kind of cheating. However, it can reduce the need for meticulous programming and sound much better than the programmed MIDI, especially in the complex rhythm patterns with emphasized, human-like accentuations that should sound like live drums.

Finally, it is important to mention that although MIDI technology is not directly used in the performing phases of the CMP of classical music, it has been present in its composing phase for several decades, in host programs like Sibelius, Steinberg Cubase, and similar.

3.3 The Influence of Advanced DSP Editing in modern DAWs

Modern DAWs include both multitrack audio recording and MIDI technology, which is why the description of their advantages and disadvantages in Table 1 structurally differs from the description of the two technical aids in the first two points. Modern DSP-based editing capabilities are tremendous and could do wonders with audio recordings. For instance, it can easily spread the drum or other forms of audio loops on an audio track. It can move ahead late audio parts played by an insecure piano player. It can straighten the sloppy beats played by a bad drummer by using close (iterative) quantizing. It can change the tempo of the audio recordings while preserving the original pitch, etc. And, of course, it can easily multiply the already recorded audio parts but—as a drawback—introduce tediousness (cf. §3.2).

One of the awe-inspiring possibilities is the selective pitch correction of the already recorded audio tracks, achieved by the DSP tools like Auto-Tune from Antares Audio Technology, and later VariAudio in Cubase, Pitch Correction in Logic, etc. Such interventions were unimaginable before the end of the last century. Back then, professional singers were supposed to sing in tune or not sing at all. While these tools can help correct the already recorded singing, they can also make the singers lazy, allowing them to depend on technology and practice less. Namely, we all know many immaculate and inspiring vocal interpretations from the past, which were recorded on magnetic tapes and mixed without any interventions.¹

On the other hand, the pitch correction tools can be used creatively to achieve “robotic” or artificial singing, as was done in Cher’s emblematic song “Believe.” As we can all guess, the singing of the famous and proficient singer did not need any pitch corrections! Her producers intended to achieve an innovative vocal effect, similar to the well-known vocoder but more distinctive and appealing in a pop song. And they decided to use Auto-Tune (Heigel, 2018). This effect became the most influential and sought-after vocal effect in the last quarter of the century. However, as with all clichés and blind following of fashion, one should note that there is a thin line between true art and cheap art, between good music and kitsch.

3.4 The Influence of AI-Based Tools

The next big technological innovation in music at the time of writing this article is artificial intelligence (AI). It can “help” composers in the composing and arranging stages, for instance, by providing MIDI content. It can “help” musicians deliver the finished digital audio *stems*

¹ The analog, reel-to-reel tape recorders can do pitch corrections, but only of the whole recorded part and only if this is prepared in advance. For instance, if the singer cannot hit a high note, the tape recorder should be played slower during recording and returned to its normal speed during reproduction. The limit for the pitch raising without unwanted audible side effects is the same regardless of whether it is done in analog or digital way. It is up or down about a half-tone (100 cents).

(portions of audio tracks) in digital format. It can “help” music producers in all phases of the CMP (cf. Figure 1). This AI assistance can be partial or, allegedly, even provide finished musical products, usually of techno-influenced pop genres with synthesized sounds and vocals (Palamara, 2023). However, if the only role of humans in that whole process is to pick among different products provided by some technical aid—which accomplished its tasks by aggregating and combining samples from other musical products provided as input(!)—can this be considered a true music art? It certainly cannot be considered humanly created art, but eventually humanly “picked” art. Also, to objectively judge such machine-produced music, we need many more such musical pieces than they are available now.

Anyway, a thorough examination of the usage of AI in contemporary music production is out of the scope of this paper and requires a separate and elaborate consideration.

4. Examples and Their Analysis

After the general deliberation of our topic in section 3 and before the concluding remarks in section 5, here we outline the analysis of a few examples from our practical works in the CMP. We start with a few musical pieces in which the first author of this paper (R. L.) has participated in different musical roles and conclude the consideration with the description of the final thesis work of the second author of this paper (I. F.), done within the frame of the elective course *Contemporary Music Production*, held on the Study of Multimedia at the University North, in Varazdin, Croatia.^{2,3}

4.1 Three Selected Musical Pieces Produced by the Authors of This Paper

Table 2 outlines the primary information on the technical aspects and the accompanying comments on the artistic facets of the music production of three musical pieces produced in the time span of thirty-one years. When piece number 1 was made in 1988, MIDI was already available, and R. L. used it in his studio. However, when he was invited to collaborate on the project as a keyboardist, the drum-machine sounds, synth-pad, and most of the guitar parts were already recorded in another, then classically organized recording studio with a professional 2-inch tape recorder. However, a time code was not recorded, so it was necessary to prepare all the arrangements in advance and play everything by hand. That required more practicing and concocting the arrangements while playing—not by MIDI programming or recording. In this way, the piano, strings, and some other (staccato) synth sound lines were arranged by playing Kurzweil K-1000 sampler player, and the synth bass line was formed and played on the ARP Odyssey analog synthesizer. After everything was recorded on separate tracks and mixed, the result was a rich, natural-sounding, smooth-jazz-funk instrumental composition. The warmth and beauty of the overall sound originated mainly from the magic of magnetic tape, while the vividness and naturalness of the performance arose from the live playing of not only the lead

² R. L. organized the audio course *Audio Engineering 1* and introduced *Audio Engineering 2* on the Study of Multimedia at the then Polytechnic of Varazdin in the academic years 2006/2007 and 2007/2008. He designed and realized an audio laboratory with separate student workplaces and one common workplace (DAW) in the range of a project recording studio. In 2008/2009, he introduced the course *Introduction to Contemporary Music Production* and ran it till 2019/2020 at the current University North, which is a successor of the former institution.

³ I. F. is a former student who enrolled in the above-mentioned audio and music production courses in one of the last generations led by R. L. In parallel to this, he has been the keyboardist and singer in a semiprofessional Slavonia- and Daruvar-based wedding band *Čista petica (Pure Five)*. He graduated from the multimedia study on October 30, 2019, after defending his final thesis (Farkaš, 2019) that dealt with the music production of a middle-of-the-road song originally performed by a doyen of Croatian pop and Dalmatian music, the late singer and pianist Oliver Dragojević (Wkp. O. Dragojević) (cf. Table 2 musical piece number 3).

acoustic guitar but also of all the other instruments except the drums. To have the drums (well) programmed on a rhythm machine was a common solution in that genre at the time. Overall, this instrumental piece turned out to be a good combination of composition and performance and achieved an excellent artistic level.

In piece number 2 in Table 2, except for arranging and playing piano and synthesizer lines, the first author of this paper took over the music production of this smooth jazz instrumental cover of the traditional gospel song. That production occurred more than twenty years after the first one in the table, when the use of MIDI was ubiquitous. The acoustic piano, as the primary and constant accompanying instrument in this music piece, was recorded in MIDI by hand. It makes the introduction and plays throughout the song but is not always the most prominent. We edited the MIDI recording slightly, with the utmost care to keep the naturalness of piano playing. The drums were either MIDI-programmed or recorded and then iteratively (nearly) and selectively quantized to preserve the slight shuffle and the feeling of real drumming. The

Table 2. Technical aids (cf. Table 1.) used in the CMP of three exemplary musical pieces produced by the authors of this paper, and the comments on the resulting artistic aspects. The hyperlinks to the locations of the songs on the Web are in square brackets.

Author and composer, producer(s) (project)	Technical aids	Additional comments and artistic aspects.
	[Hyperlink to the web soundtrack]	
1. Davor Daga Devčić, instrumental: <i>The Seduction Theme</i> (in Croatian: <i>Zavođenje</i>). Produced by D. D. Devčić & Branko Podbrežnički (1988).	<ul style="list-style-type: none"> • Multitrack recording on an analog 24-channel tape recorder (Studer) with 2" magnetic tape. • Programming the drum machine (Oberheim DMX), using shuffle. 	<ul style="list-style-type: none"> • The author played the lead theme on acoustic guitar, achieving a high artistic level. • Except for the programmed drums, all other prearranged music lines were recorded by two keyboardists who played their synthesizers by hand (Sequential Prophet-600, Kurzweil K-1000, ARP Odyssey).
	[https://soundcloud.com/tango_collection/1988-zavo-enje]	
2. Traditional gospel song <i>As the Deer</i> ; saxophone arrangement and performance by Dave K. (David Kocijan). Produced by Robert Logožar (2009).	<ul style="list-style-type: none"> • MIDI arrangement and recording + editing of piano, bass, and strings lines; programming of drum parts. • Multitrack audio recording of sax lines in the Cubase SX DAW. • Partly automatized mixing in Yamaha DS-2416 sound card. 	<ul style="list-style-type: none"> • The soloist arranged and played the lead and the accompanying saxophone lines on the initial, MIDI-produced song matrix, with MIDI-recorded piano and programmed tempo changes. • Good song matrix enabled a high level of artistic performance of the academically educated saxophone player. • All other MIDI-based musical lines were minutely edited in accordance with their sounds to achieve a natural and humane musical flow.
	[https://www.youtube.com/watch?v=SCUe7OJLY5A]	
3. Aleksandar Radulović and Marina Tucaković, song (in Croatian): <i>Što to bješe ljubav</i> (<i>Remind Me What Love Was</i>). Produced by Ivan Farkaš (final thesis) and R. Logožar (2019).	<ul style="list-style-type: none"> • Sampling the drums. • MIDI programming, recording, and tempo editing. • Multitrack recording of vocal and el. guitar in Cubase 5-based DAW. • Slight pitch correction of the vocal recordings. 	<ul style="list-style-type: none"> • A typical Croatian middle-of-the-road song was reinterpreted in its original arrangement and sung by the first producer (I.F.). • Background instruments were programmed in MIDI. I.F. recorded the piano part in MIDI, to enable slight corrections and tempo changes. Live el. guitar parts, and the gentle and emotional vocal performance contributed to the satisfying artistic level of the song.
	[https://soundcloud.com/ivan_farkas29/cover-sto-to-bjese-ljubav]	

electric bass line was MIDI-recorded by hand and then edited as needed, again with the aim to simulate the real playing, with portamentos, holding, and wire muting (stopping), as a proficient bass player would play it. After the instrumental matrix was prepared in MIDI and the tempo minutely adjusted, we recorded the sax lines, arranged by the saxophone soloist. The highly artistic and brilliant saxophone performance gave this instrumental piece vividness, expressiveness, and great appeal that even the best vocal performance of this song would not outperform.

On the other hand—to keep the same level of criticism—could we say the same for the other accompanying parts? While the arrangement is in the full function of the song and very satisfactory, the MIDI-played parts do lack some of the naturalness of live playing. However, performing all these musical lines live would require several more proficient and well-trained musicians, while, in this case, only two performed and fully produced this musical piece. Regardless of the slight objections, this version achieved considerable popularity and excellent criticism on the leading artist's YouTube music channel.

Ten years after the second example production, R. L. was a music production mentor to I. F. in his endeavor to produce a cover of a popular song performed originally by Oliver Dragojević, one of the most famous Croatian singers ever (cf. footnote 3). The result is the musical piece number 3 in Table 2. I. F. bravely decided to produce one of his favorite songs as his final thesis, although he would have to sing a song of such an excellent predecessor (Farkaš, 2019). His idea was to produce this song close to his band's live performance but with a few technical substitutions because of personal and technical limitations. First, the drums would be MIDI-programmed, and the electric bass, too. However, to preserve the good original sound of the band drummer's drums (TAMA StarClasic), I. F. recorded the samples of their sounds and inserted them into Cubase Groove Agent. Then, he programmed the drum parts, mainly following—as was done for all other instruments—the original song arrangement. The synth pad, strings, flute, and horn were also MIDI-programmed, played, and edited. The piano was MIDI-recorded by hand and then subtly edited. The piano MIDI track played the acoustic piano sound from the Korg Kronos 2-61 keyboard. I. F. recorded the audio tracks in his improvised home studio: the electric guitar played by his band guitarist and his own vocal lines. Up to this point, this production was—generally speaking—not much different from the production in the previous example (number 2 in Table 2). However, in this case, I. F. did use the advanced DAW's editing capabilities to correct the pitch of his vocals in a few places. In the previous project, this technical aid was neither available nor needed. This production was finalized by R. L., who finished the mixdown of the song. The mastering phase was reduced to the simple normalization of the recording. Thanks to the good vocal performance and solid instrumental accompaniment, the achieved artistic level can be considered good.

4.2 Presentation of the Selected Students' Works

Table A.1 in Appendix A presents the additional fifteen examples of the musical pieces produced by the students who attended our music production course. The table's last row gives the latest work from the series of mentorships led by R. L. —which is the already described musical piece number 3 in Table 2, coproduced by I. F. and R. L.

Of the sixteen included musical pieces, fourteen are from the students' final theses, and two are from the better seminar works (numbers 2 and 10). In the written materials accompanying the audio files, especially those for the final theses, the students had to describe precisely what they were doing, starting from a thorough description of the musical background of their project. That included the sheet music presenting at least the melody with the chords, the structure of the song by bars (including the chords), essential parts of the arrangements, etc.

An interested reader can check how the produced music sounds by clicking on the provided hyperlinks or by transferring the internet addresses to a web browser. For the items from number 12 and up, one can access the final theses' files via the links in the leftmost column.

The students' works range from good demos to true professional works—of course, judging the musical pieces primarily by the quality of music production. Furthermore, unlike the first two examples from Table 2—which were results of the professional engagement of the production contributors and were technically adequately supported—the students' productions were burdened by several difficulties. Namely, some students could afford to rent a recording studio or get free hours to realize their projects. The others had to improvise and use either the university's audio laboratory (cf. footnote 2) or their home-improvised studios. The former was well-equipped and acoustically treated but did not offer recording of live drums. Of course, technical problems were not the only obstacles the student producers were facing. Finding proficient musicians willing to cooperate in their music projects was another, often harder task.

In the description of a few pieces from Table A.1, we can start with number 1. The second producer, M. Lajtman, owned a well-equipped professional recording studio ready for this music production, as was described in (Logožar & Lajtman, 2011). With his friends from the band *Komedija*, he produced a professionally sounding rockabilly song using the classical rock production procedure. Besides that, M. Lajtman helped his colleague student and friend, the singer-songwriter N. Friščić, to produce a few of his rock grunge songs, including the excellent one described in the table under number 8.

Furthermore, piece number 6, composed, arranged, and produced by I. Prohaska, shows how good pre-production (arranging) and selection of good musicians lead to a professional-sounding gypsy jazz soundtrack, even though the tracks were recorded instrument by instrument in our small audio laboratory. Similarly, piece number 12, arranged and produced by K. Perhoč, presents an excellent production of a Croatian old-town style folk song, played live by versatile tamburitza players and sung by an excellent vocalist.

Musical piece number 4 presents a good instrumental led by an excellent guitar player, inviting a vocal interpretation of the existing lyrics to fulfill the song. Two alternative rock songs, presented at number 5, are another example of a good classical rock production with all instruments recorded live. Not far from that is the hard rock piece number 7, with distinguished guitar playing and vocal performance. However, this example shows how one weak link in the production chain—in this case, the imprecise drumming—can spoil the final product. In a similar manner, some imprecisions and technical problems with the drum recording slightly spoiled the modern punk-rock song at number 13. The piece at number 3 is a gentle and refined pop song that could benefit from better drum lines and the mixdown, and the jingles at number 14 are ready for use in an appropriate context.

The other pieces from Table A.1 that are not explicated here are by no means less worthy than those just mentioned. The technical aspects of their production and the achieved artistic levels are described in the table. Most of them are solid demo recordings that are ready for either more elaborate productions (2, 10, 15) or can be used as trial demos for further evaluation of how the songs should be produced in the future (9, 11).

5. Concluding Remarks

Unlike the technical aspects of the CMP, the artistic aspects of the music we hear are hard to define and can be highly subjective. However, although it cannot be easily defined, the artistry in music is very easily recognized, which is similar to the situation in other arts. It assumes the full musical technical proficiency, or the musical craftsmanship, and then also *something more* that we humans appreciate as art. Thus, the only remaining undefined part

here is that “something more.” And the connoisseurs of a particular musical genre, let’s say the benevolent ones, can easily determine what that is and what isn’t.

Moreover, even non-musical experts can easily recognize the overall artistry of the performed music. A musical piece of some genre can be—without going into too much detail—easily qualified as good craftsmanship if it is well composed, arranged, and professionally performed and produced. If it also has that special addition that touches and inspires people, all the better—one can then appraise it as art (hopefully not kitsch!). A devoted fan of some music genre can also quickly tell if a soundtrack she hears is good, excellent, or just bad. This judgment should be an even easier task for professional musicians and producers.

Thus, although the artistic level is not strictly definable, and although—to paraphrase the famous saying—“beauty is in the *ear* of the beholder,” a benevolent critic will first demand the full technical correctness and mastery of the musical performance and music production and then—as an expected bonus—also a favorable artistic impression, usually named *musicality*, of both performance and the final soundtrack.

In this paper, we have shown and discussed how technical aids helped musicians and music producers not only finish their job earlier and with fewer repetitions, but also enabled them to refine their compositions, arrangements, and performances, as well as add expressive musical effects that were impossible in the old music production technology. On the other hand, all technical aids have pros and cons, and music producers must be aware of both, especially the pitfalls of the latter.

The analysis in the previous sections, specifically in sec. 4, showed that using technical aids, especially MIDI, is highly dependent on the music genre. For instance, the use of MIDI-programming of drums or different versions of drum machines is the widespread standard in pop, former disco and today’s dance, techno, and other electro genres (Table 2). The “old-fashioned” drum machine programming worked excellently in our piece number 1 in Table 2, and the more elaborate MIDI programming of drums did very well for the other two pieces in that table. When using this aid, one must achieve the desired rhythm flow, groove, “feel,” and sound, or otherwise risk an inferior result. If this is hard to accomplish by MIDI programming or recording, and a good drummer is unavailable, using the drum loops may be helpful, as we have commented in §3.2 and §3.3 (a good suggestion for pieces 3 and 9 in Table A.1).

However, to get back to the use of MIDI or other ways of programming musical sequences, it would be unfair not to mention the masterpieces and keystones of modern electronic music, such as Kraftwerk’s *The Robots* from the album *Man Machine* and the New Order’s single *Blue Monday*. The artistic level achieved in both these songs is superb, and the drum machines’ strictly quantized and automated rhythm fits them perfectly. Still, both pieces have several *natural* and *humane* elements. In the first, the rhythm is probably played by some old, modified, and upgraded analog drum machine, and the sequencers were triggering the warm and vivid sounds of old analog synthesizers, among them also the unsurpassable Mini Moog.⁴ On top of all that, the vocoder sound appeared robotic but was also highly artistic. In the second example, New Order used the quantized and highly automatized sounding drum machine rhythm, but along with it was the electric bass line played by hand with a pick and a suiting, resigned vocal.⁵

On the other hand, using MIDI technology for the rock genres in general does not produce the desired result, both sonically and artistically. We have noted this for pieces 9, 10, and 11 in Table A.1. In rock, one can use MIDI to finish the composing and arranging phases of the

⁴ The exact musical equipment used for the production of this song and album is very hard to determine. Some information can be found in (MusicTech, 2014; Gearspace 2010 – 2013).

⁵ The drum machine used in this song was Oberheim DMX. A careful reader might have noticed that the same drum machine was used in our piece number 1 (Table 2).

pre-production, but then it is time to engage real musicians. Even in such reduced use, there is a risk of departure from the crucial genre features, as happened in piece 11 in Table A.1.

As a general rule of thumb, we may conclude that the justifiability of using technical aids in the CMP is very genre-dependent. Besides that, it is always refreshing to have some genuine human contribution that brings liveliness and vibrancy to the musical piece and breaks the possible repetitiveness and monotonicity of the background instrumentation—especially when the latter is a determining feature of the music genre. We have also shown that for the high-quality production of most genres, it is good to have as many adept musicians as needed and to record them live. Good multi-instrumentalists are very welcome in the recording studios, as they can substitute many players (cf. piece 13 in Table A.1). On the other hand, every new proficient musician can contribute to the richness of the final soundtrack. Such an approach sounds not only logical but also fair for hard-practicing musicians, who could later participate in the live performance of the produced musical pieces.

Finally, when we finish recording audio tracks or arranging MIDI parts that play nice sounds, where do we stop with their editing and polishing in our quest for the perfect performance and the right sound? A good piece of advice is to appraise whether they are satisfactory in the first place. If not, it's always better to decide about the needed changes and to make the recording again. If yes, the editing should not “spoil” the genuine artistry of a human vocal or instrumental performance and make the recording too sterile. On the other hand, if such “over-editing” does contribute to the artistic level of the musical piece, that is the case when contemporary music production (CMP) might take an active and creative role in creating music! After all, haven't we already said: “Beauty is in the ear of the beholder.”

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Appendix A. Musical Pieces Produced by Students

In Table A.1 we outline the selected students' music production works that were mainly completed within the students' final theses from the area of the elective course *Contemporary Music Production*. The course has been held at the Study of Multimedia at the University North, in Varazdin, Croatia, since the academic year 2008/2009, and was led by the first author of this paper (R. L.) from its beginning until 2019/2020 (cf. footnote 2).

Table A.1 As Table 2, but for the works of the students who attended the course *Introduction to the Contemporary Music Production*, mentored by the first author of this paper (R. L.). Additional abbreviation: *fin. ths.* = production realized as part of the student's final thesis.

Author and composition, producer(s) (project)	Technical aids [Hyperlink to the web soundtrack, if available.]	Additional comments and artistic aspects.
1. Igor Baksa (band: <i>Komedija</i>), song: <i>Psychobilly</i> . Produced by Mario Jagec and Marko Lajtman (fin. ths., 2010).	<ul style="list-style-type: none"> • Multitrack audio recording in the Nuendo 3.2-based DAW (IF-FW/DmmkII sound card and Tascam DM 3200 digital mixing console). 	<ul style="list-style-type: none"> • The song was fully defined, with the arrangement of brass instruments in sheet music. • All musical lines were performed by musicians and recorded directly as audio (no MIDI). • Instrument-by-instrument recording: drums, el. bass and el. guitars, vocals, and the brass section, one instrument at a time.
2. Bojan Drvarek and Robert Logožar, song (in Cro.): <i>Bezazlene misli</i> (<i>Guileless Thoughts</i>). Produced by B. Drvarek (student work), superv. by R. L. (2010).	<ul style="list-style-type: none"> • Arranging and recording + editing of the drums, bass, and keyboard lines in MIDI. • Multitrack audio recording of vocals in the FL Studio-based DAW. 	<ul style="list-style-type: none"> • The standard music production procedure of a song in the hip-hop genre. • Combines the elements of a classical guitar theme by D. Aguado) with the hip-hop rhythm. • The vocal parts performed as rapping and singing keep the song exciting and grab the listener's attention to this good demo recording.
3. Karmen Bogatinovski and Ivan Ferencak, song: <i>To Belong</i> . Produced by K. Bogatinovski and I. Ferencak (two fin. theses), supervised by R. L. (2011).	<ul style="list-style-type: none"> • Arrang. and recording + editing the drums and keyboard lines in MIDI. • Multitrack recording of acc. bass, guitars, and vocals in Cub. 5 DAW. • Automatized mixing in the DAW. 	<ul style="list-style-type: none"> • Direct audio recording of el. bass and el. guitars added to the vividness of the final product. • The saxophone theme, performed via MIDI-triggered samples, lacks the proper expressivity. • Sensitively and smoothly performed vocal lines created the basic soft, tender, and soothing atmosphere of the song.
4. Nikola Kahriman and Robert Logožar, song: <i>Over the Meadows</i> . Produced by Nikola Kahriman (fin. ths.) & Petar Horvat (2011).	<ul style="list-style-type: none"> • Multitrack audio recording in the Cubase 5-based DAWs in three studios: two for recording and one for mixing. 	<ul style="list-style-type: none"> • Standard music production procedure of a rock song based on the guitar and live drums sound, with the lead guitar playing the vocal theme. • The producer (and the first author) gathered musicians and coordinated the recording. • The final product resembles the vivid grunge rock sound and performance.
5. Domagoj Ivanković and band Blindspot, songs: <i>My Friend</i> and <i>The Knot</i> . Produced by Ivan Ban (fin. ths.) & P. Horvat (2011).	<ul style="list-style-type: none"> • Multitrack audio recording in Cubase 5-based DAW (RME Hammerfall System Multiface). 	<ul style="list-style-type: none"> • Standard music production procedure of an alt. metal rock song based on the guitar sound. • The band members defined and arranged the song and practiced it before the recording. • The final audio product resembles the solid and natural alternative metal rock sound.

Author and composition, producer(s) (project)	Technical aids	Additional comments and artistic aspects.
<i>[Hyperlink to the web soundtrack, if available.]</i>		
6. Ivan Prohaska, gypsy jazz instrumental: <i>Cest' La Vie</i> . Produced by I. Prohaska (fin. ths.), supervised by R. L. (2012).	<ul style="list-style-type: none"> • MIDI composing and arranging, prep. of the sheet music; MIDI rec. & edit. of the double bass line, metronome. • Multitrack recording in Cubase 5-based DAW, instr. by instr., part by part (punch-in/out). 	<ul style="list-style-type: none"> • MIDI was used mostly in the preparatory stages. After the first producer could not find the double bass player, the bass line was recorded as MIDI, playing a suitable sample. • Guitar and viola parts were played by hand by the students of the Zagreb Musical Academy. • Minute tempo programming resulted in the great naturalness of the performance despite the separate track recordings.
[https://www.youtube.com/watch?v=DN4GAXU43Ik]		
7. Vedran Hrenić and Goran Fabijanović, song (in Cro.): <i>Rođen ponovo (Born Again)</i> . Produced by Branimir Habek (fin. ths., 2012).	<ul style="list-style-type: none"> • MIDI composing and arranging a draft version of the song. • Multitrack audio recording in the Cubase 5-based DAW (various hardware). 	<ul style="list-style-type: none"> • MIDI served to define the song and arrangement; after that, the standard rock production took place with the instrument by instrument, and part-by-part recording (punch-in/out). • Good performance of the backing and solo guitar lines and an excellent vocal performance contributed to the song's good artistic level.
[https://youtu.be/SI407gZghMw?si=xNiavtLG7dIk8yP]		
8. Ninoslav Friščić, song: <i>The Moon</i> . Produced by M. Lajtmán and N. Friščić (fin. ths., 2012).	<ul style="list-style-type: none"> • As above, in pt. 3. • MIDI recording; the sounds were played from Reason 4. 	<ul style="list-style-type: none"> • MIDI was used for the piano line only. • Classical rock production, based on electric and classical guitars, electric bass, and live drums. • The authentic grunge rock sound and excellent artistic expression were achieved.
[https://www.youtube.com/watch?v=qIm76XrZs-U]		
9. Robert Logožar and Boris Sever, song: <i>The World of Love and Hate</i> . Prod. by R. L. and Ilija Stipetić (fin. th., 2012).	<ul style="list-style-type: none"> • MIDI composing and arranging a full instrumental song version. • Multitrack recording of the guitar and vocal lines in Cubase 5-based DAW (E-MU 1616M). 	<ul style="list-style-type: none"> • The MIDI-produced instrumental version of the easy rock song served as a matrix. • El. bass, el. guitar, and vocal lines were recorded later on the basis of the MIDI template. • Slight problems with the rhythmical flow and naturalness of the performance were noted. The live drum recording would be beneficial.
10. Robert DeLeo, Scott Weiland Eric Kretz (band: <i>Stone Temple Pilots</i>), song: <i>Plush</i> . Prod. by Nenad Naranđa and Josip Žukina (stud. work), superv. by R. L. (2014).	<ul style="list-style-type: none"> • MIDI programming of drums and el. bass (original arrangement). • Multitrack recording of the guitar lines and vocals in Cubase 5-based DAW (E-MU 1616M). 	<ul style="list-style-type: none"> • The task was to produce a cover of the grunge-rock song picked by the first producer. • The MIDI programming was not elaborate and it diminished the artistic impression a bit. • Good performance of the guitar lines (2nd producer) and excellent vocal performance (1st producer) resulted in a very good demo song.
[https://www.youtube.com/watch?v=mk2C3evsZMo]		
11. Robert Lexton, song: <i>The Old Rocker</i> . Produced by R.L. and Josip Žukina (fin. ths., 2016).	<ul style="list-style-type: none"> • MIDI composing of a song sketch, MIDI program. of drums, bass, and keyboard lines. • Multitrack recording of the guitar lines in Cub. 5-based DAW (see 10). 	<ul style="list-style-type: none"> • The task was to upgrade the MIDI sketch of a classic rock song with guitar lines. The melody was played by a MIDI-recorded flute. • MIDI-based approach and over-arranging of the keyboard and guitar lines botched the project. • Alongside this, various guitar sounds and styles were investigated.

Author and composition, producer(s) (project)	Technical aids	Additional comments and artistic aspects.
[Hyperlink to the web soundtrack, if available.]		
12. Traditional song (Croatian): <i>Ne vrijedi plakati (It's Not Worth Crying About)</i> , sung by Karlo Čeh. Produced by Karlo Perhoč (fin. ths.), supervised by R. L. (2016).	<ul style="list-style-type: none"> • MIDI arrang. and sheet music in Sibelius 5. • Metronome guided multitrack recording and editing in Cub. 5-based DAW (Fireface UC). • Rec. instr. by instr., part by part (punch-in/out). 	<ul style="list-style-type: none"> • Music production of a traditional Croatian song in old-town style with <i>tamburitza</i> band accompaniment.⁶ • The elaborated original song arrangement and skilled and trained tamburitza players contributed to the natural and expressive performance. • High artistic level is achieved.
[https://www.youtube.com/watch?v=n0JLALOGkNk]		
13. Mislav Bunić, song (Croatian): <i>Iz nekog novog svijeta (From some new world)</i> . Produced by M. Bunić (fin. ths.), supervised by R. L. (2017).	<ul style="list-style-type: none"> • MIDI piano part, metronome with var. tempo. • Multitrack rec. and edit. in Cub. 5 DAW (MIDAS Venice F24, Focusrite Scarlett 2i2). • Rec. instr. by instr., part by part (punch-in/out). 	<ul style="list-style-type: none"> • The singer-songwriter, an avid follower of modern punk-rock, played all main rock instruments: drums, el. bass, and el. guitars as best, and confidently performed the vocal parts. • Solid performance and knowledge of the genre contributed to the artistic level of the final product. However, some problems with the drum recordings distract the listeners.
[https://zir.nsk.hr/islandora/object/unin%3A4666]		
14. Johannes Brahms, <i>Hungarian Dance No. 5</i> ; Lovro Kolar, instrumental: <i>Driving Through the Desert</i> . Produced by L. Kolar (fin. ths., 2018).	<ul style="list-style-type: none"> • MIDI composing, programming and arranging of instrumental versions in FL Studio DAW. • Automated mixing of the sounds from plugin synths and samplers. 	<ul style="list-style-type: none"> • Two compositions were produced in the form of extended music jingles, combining the genres of electronic dance music and soft techno. • The producer achieved modern, techno music art through elaborate MIDI programming and the usage of rich sound effects.
[https://zir.nsk.hr/islandora/object/unin%3A2028]		
15. Tin Obradović and Domagoj Butković, song: <i>Greed</i> . Produced by D. Butković (fin. ths.), supervised by R. L. (2018).	<ul style="list-style-type: none"> • MIDI composing and arranging in Guitar Pro, Audacity and Cubase 5. • Multitrack rec. of el. guit., voc., and drums in the above DAWs. 	<ul style="list-style-type: none"> • MIDI-assisted production of a metal song. The lack of a bass player was compensated by a MIDI-programmed bass line. • Live playing of drums and el. guitars and an adequate vocal performance contributed to the right sound of the metal genre demo.
[https://repozitorij.unin.hr/islandora/object/unin%3A6223]		
16. See Table 2, mus. piece #3. Produced by I. Farkaš and R. L. (2019).	See Table 2, musical piece #3.	
[https://soundcloud.com/ivan_farkas29/cover-sto-to-bjese-ljubav]		

⁶ Tamburitzas are national Croatian folk string instruments similar to mandolins (Wkp. Tamburica).