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How to Prepare Recorded Material for Online Mixing and Online Mastering?

Practical Guide for Amateurs and Professionals

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ABSTRACT

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HIILESMAA, HIILI:
How to Prepare Recorded Material for Online Mixing and Online Mastering?
Practical Guide for Amateurs and Professionals

Master's thesis 51 pages
August 2020

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New technology has lowered the prices of recording equipment so that it is available to almost everybody. Today, many artists carry out their record projects with their own recording equipment and use online services in the mixing and mastering phases. Objective vision, experience and high technology are required for these production phases. There are plenty of artists who do the recording themselves, but very little material is available for them on how to prepare the recorded material for online mixing and mastering.

The goal of this thesis was to provide useful information on how to develop working methods, which make online mixing and online mastering processes more efficient. There are no rules or standards in the industry for what kinds of technical measures or decisions should be made when preparing the recorded material for online mixing or online mastering.

The purpose of this thesis was to provide a practical guide for those, who are planning to carry out their mixing or mastering phase online, and to develop Hiili Music's online services, who is the subscriber to this thesis. In addition, a purpose was to provide useful ideas for sound engineers, who are interested in developing their services. The sources used are Hiili Music's archives, literature and online sources. The thesis has a constructive approach. The material was collected by researching materials from dozens of music albums and mapping out the problem areas that emerged from them.

The final results showed that a big budget is not as important a factor as is often thought, but instead careful preparation is required. The recorded material should be delivered with sufficient technical quality, and many decisions must be made in advance. Interaction plays a much more important role than the industry thinks. A good production is born of interaction and collaboration.

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Key words: music, mixing, mastering, online

CONTENTS

ABBREVIATIONS AND TERMS

DAW	Digital Audio Workstation.
DDP	Disc Description Protocol (DDP) is a format for specifying the content of CDs.
DI-signal	Direct Input signal. The high impedance signal is reduced to low impedance level.
ISRC	International Standard Recording Code (ISRC code) is a unique identification system for sound recordings. Each ISRC code identifies a specific unique recording and can be permanently encoded into a product as a kind of digital fingerprint.
Keynote	Keynote in music, the first note (degree) of any diatonic (e.g., major or minor) scale. It is the most important degree of the scale, serving as the focus for both melody and harmony.
MIDI	Musical Instrument Digital Interface (MIDI) is a technical standard that describes a communications protocol, digital interface, and electrical connectors that connect a wide variety of electronic musical instruments, computers, and related audio devices for playing, editing and recording music.
Multitracks	The recorded separate, individual elements of an audio production.
Re-amping	Re-amping is a process often used in multitrack recording in which a recorded signal is routed back out of the editing environment and run through external processing using effects units and then into a guitar amplifier and a guitar speaker cabinet or a reverb chamber.

1 INTRODUCTION

New technology has lowered the prices of the recording equipment so that it is available to almost everybody. At its simplest, a home studio is a laptop with a DAW, an external sound card and headphones. Today many artists carry out their record projects with their own recording equipment and use online services in mixing and mastering phases. However, objective vision, experience and high technology are sought for these production phases. There are plenty of ones who record themselves, but very little material available for them how to prepare for online mixing and mastering. As Doctor Brecht De Man states in his Degree of Doctor of Philosophy: "The emphasis is strongly narrowly on the signal processing side" (De Man 2017, 3).

The goal of this thesis is to provide information how to develop working methods that make online mixing and online mastering processes more efficient. How to help sound engineers not make the same mistakes others have made earlier? How to package recorded tracks and deliver materials online successfully and thereby reduce stressful situations? What all needs to be considered to save time and budget?

The purpose of this thesis is to provide a practical guide for those who are planning to carry out their mixing or mastering phase online and develop Hiili Music's online services which serves as the subscriber to this thesis. In addition to the previous ones, a purpose is to provide useful ideas for sound engineers who are interested in developing their services. Managers, promoters, and record labels can also benefit by learning to understand better the music album production process.

This thesis has a constructive approach. The thesis focuses on real-life problems that are perceived as necessary to solve in practice (Lukka 2000). The sources been used are Hiili Music's archives, literature and online sources. The applied material was collected by opening and researching materials anonymously from dozens of music albums and mapping out the problem areas that emerged from them. As one of the core features of the constructive approach,

the researcher and the company work very closely together and where experiential learning is expected to take place (Lukka 2000). The problem areas found have been examined more closely and practical solutions have been developed. Lukka (2000) states that one of the core features in constructive approach is that it includes an attempt to implement the developed construction to test its practical suitability. This feature is included in this thesis as well.

Hiili Music is a music production company where the author has worked as a music producer since 2000. The company has started offering online services in the first half of the 2010s. The author has held workshops on online mixing and mastering processes at Rytmi-instituutti, Rock Academy and in Tampere University of Applied Sciences (TAMK), where he gives music production lectures regularly.

2   TRADITIONAL AND ONLINE WORKING ENVIRONMENTS

There have been huge leaps in studio technology in the 21st century. High-speed internet connections have revolutionized the music industry in many different ways. Many analog studio devices have been digitized into software format. Mixing and mastering phases have also changed significantly. Still, after the recording phase an external sound engineer is often hired, although in principle mixing or mastering can be carried out at home conditions. Neutral and impartial vision is needed. According to engineer Frank Filipetti, there are not that many people that have that objectivity. You need someone to bounce ideas off, I think that's why engineer / producer started to happen. (Filipetti 2000, 2.)

2.1   Mixing phase

Figure 1 shows that mixing phase is performed after pre-production and recordings.
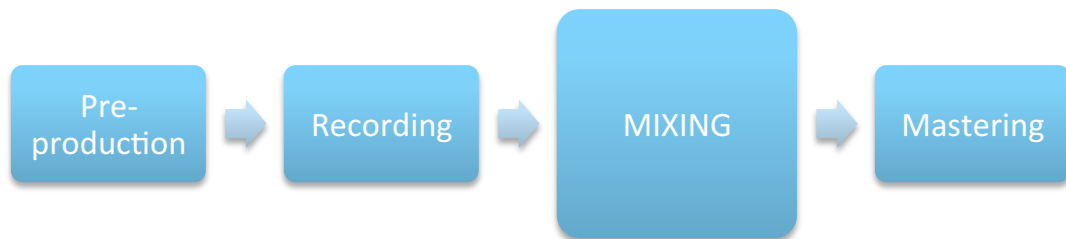
FIGURE 1. Music production phases

Mixing in the traditional way required that all parties gathered at the same time at the same place to listen to the mix when each song was about to be completed. The studio had to be reached whenever something was about to be completed which meant nearly every day. If there were several parties involved, there was a lot of traveling, often to different countries as well. In addition to the artist or the band there was usually a record company representative. This has been burdensome for sustainable development.

Earlier, the technical issues posed many challenges. The studio monitoring system was usually unfamiliar to the client, although difficult and decisive decisions had to be made in an instant. When a single song was completed, there was no return unless the budget was particularly large. Mental pressures were intense and stress often affected the course of the process. Such a situation can negatively affect the outcome, if decisions have to be made in an instant and there is not enough time to reflect on them. In an interview psychotherapist Katja Hietanen states that when mind gets stressed in a long process, one start to look for threats. The field of vision narrows. In such a state of mind, it is impossible to approach mixing and doing objectively. (Hietanen 2014.)

The online mixing environment has made a real change. When the mixing engineer has completed the first mix, one can send the result for comment over the internet. While the client becomes familiar with the mix, the engineer can work with the other songs. The client can listen the mixes in peace in their own time. The mixes can be listened to as many times as wanted with the clients own familiar monitoring system. According to engineer Justin Perkins, "I never knew what it actually sounded like because I was not familiar with listening to music in that room on those speakers. I was not in a position to make suggestions because it was a foreign listening environment." (Perkins 2020.) The physical location of the client and the studio does not matter. This supports sustainable development and open the market to a wide international area.

Today difficult artistic solutions are less stressful to make, because it is easy to open the mixes in DAW afterwards and make adjustments. Once the client has made decisions about the changes that one wants to make to the mix, a list of change requests can be provided to the mixing engineer. The mixing engineer does not have to be present and expensive studio time does not go by when musicians and record company representatives resolve artistic disagreements.

While the use of time is more flexible, it is also good to keep in mind that sometimes the line has to be limited. The engineer must be able to be empathetic but at the same time determined. According to producer Jason Moss, the mix is one of the final steps of the music-making process. After months (or even years) of

work, your client must commit to a final product and move forward. For many, this can be a scary moment. It's common to encounter a lot of insecurity, indecisiveness, and endless tweaking. (Moss 2020.)

A big challenge in the online environment is to build trust between the client and the engineer. Through the internet, it can be much more difficult than spending time in the same space. According to professor Vittorio Gallese (2011,89) social identification, the "selfness" we readily attribute to others, the inner feeling of "being-like-you" triggered by our encounter with others, are the result of the preserved shared we-centric space (Gallese 2011). This kind of interactions are impossible to achieve in an online environment. If some things requires to be resolved on the spot, for such things can be booked, for example, one studio day when everything is otherwise ready and the pressures begin to ease.

2.2 Mastering phase

The mastering phase differs in many ways from the mixing phase. Figure 2 shows that the mastering follows the mixing phase.
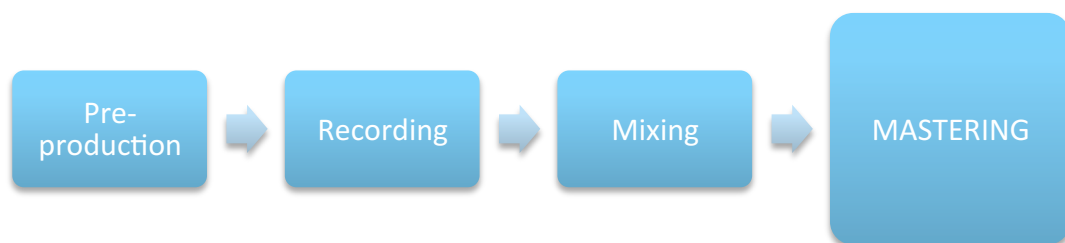

FIGURE 2. Mastering is the last phase in record production

Previously, the materials had to be delivered as physical tapes to the mastering engineer, who copied the files and processed the mastering. Selected versions of the songs had to be carefully marked on the tapes, if the client did not participate in the mastering phase.

The mastering phase began to move into the online era much earlier than the mixing phase. Mastering is much simpler to implement in an online environment than a mixing process, because the mixing is already completed and only stereo tracks are worked on as a rule. The files to be mastered are easily transferred online. However it is good to send the files early enough to make sure everything works properly. According to Perkins, "I can't tell you how many times a client showed up only to realize they had brought or sent me ahead of time the wrong file for a song or multiple songs. When this is discovered at the mastering session, this becomes a serious misuse of time for both parties." (Perkins 2020.)

In mastering phase a creative part for the client is to work out the spaces between the songs. However, in addition to the general sound, it is easy for the client to comment the spaces afterwards. It usually takes one studio day to master an average ten-track album album, so participation is not that crucial in that sense either. Surely, attending to the mastering session has its own vibe and in some cases it can be necessary, but it takes more working time from the mastering engineer. Often budget and scheduling go beyond that. According to Perkins, If "I were to do all attended mastering sessions, I would have to raise my rates to account for the extra time and logistics involved. With this method of operation, bands, artists, labels, clients, etc. can now choose what's best for their project." (Perkins 2020.)

3   SIGNIFICANT INFLUENCERS

When preparing for online mixing and online mastering, many variables have to be considered and find a balance between them. Mixing and mastering are multi-level jobs. The engineer must use his knowledge, skill and his own emotional scale professionally.

Although the projects are different in nature, there are common influences that are appropriate for most projects. Producer Jukka Puurula (Puurula, 11) says that a record production is a triathlon of art, economics and technology. You do not need to be the best in every sector, but to be successful the recording requires consideration of every sector. All components support each other. (Puurula 2012.) In the online environment, interaction also becomes one of the most important sectors. Figure 3 shows the four significant influencers.
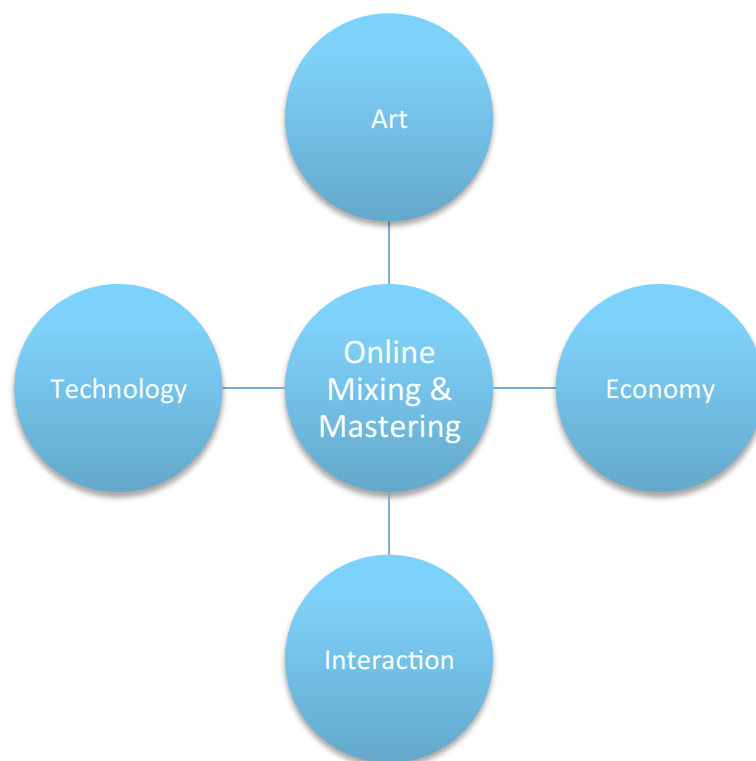
FIGURE 3. The four significant sectors of record production

3.1 Art

When preparing to a mixing process it is important to decide how much artistic impact is wanted from a mixing engineer. Are the engineers references appropriate for particular style of music? Should the engineer just mix the multitracks where all the edits are finalized or should the engineer also fine tune the tuning and timing? There should a sort of an agreement what it comes to possible additional, if the mixing is done online and the client is not in the studio influencing choices.

3.2 Technology

How to pack materials in such a way that they work seamlessly with the engineers DAW? Which tracks should be delivered and which tracks should not? Should plug-ins be removed or not and what about their settings? The process stops at the very beginning, if the delivered material does not open properly in the engineers DAW because of a wrong audio format.

3.3 Economy

Nearly every production has a budget, but today it is common that a client do not know what measures the production requires. Whereas in the past the productions were funded by the record companies more often, the artist did not need to have as much expertise in this matter as one does today. Today, the engineer should guide the client to get the most out of the budget available more than earlier. Producer Glen Ballard notes that we sometimes do in the studio is we spend 90 percent of our time on stuff that is worth about 10 percent (Ballard 2000, 23). An experienced mixing engineer is able to do a lot of additional tasks when mixing: Choose takes, re-amp the tracks, fine tune timing etc, but what could be done by yourself? How to save the budget and direct it on more important targets?

3.4 Interaction

In an online environment, communication skills and empathy are emphasized because the parties do not come together. It is a matter of making art in cooperation between the engineer and the client. The relation needs to be built through the internet that is demanding compared to being in the same space.

Architect Juha Ilonen's description of the relationship between the architect and the client is also well suited to describe the relationship between the engineer and the client in music field. Both have a customer relationship, budget, creativity is strongly present and interaction must be in order. Ilonen wonders if an architect and a client can be on the same level mentally. Does the client really understand what it means to recruit an architect. They need to be able to trust each other. The client needs to know what an architect is doing and what is not. For example, an architect not only pre-draws a client's ideas about shapes and colors, but it's about dialogue. The customer does not buy the product but the process. (Ilonen 2015.)

4   PREPARING THE MATERIAL FOR ONLINE MIXING

This section discusses in more detail how the recorded material can be delivered to the mixing studio so that the audio files open correctly in the mixing engineers DAW.

4.1   Supply multitracks instead of a DAW session

It is recommended to send multitracks, not a DAW session. There are many risks if the whole session is sent. Is the DAW update the same? Has the client set the automations the way that it fits to mixing engineers vision? Does the mixing engineer use the same plug-ins that the client is using? Abbey Road Studios inform in their official website, that the studio cannot accept DAW sessions i.e. Pro Tools, Logic, Cubase etc. (abbeyroad.com 2020).

4.2   Choose the right takes in advance

One might think that a mixing engineer could choose the best takes form lead vocals for example, because the mixing engineer is professional and objective. The purpose of the mixing phase is to focus on mixing and the best takes should be selected by the time the mixing phase starts.

It would take a lot of time if several different takes were to go through and make a selection by the engineer. This method could also start a debate as to whether the take chosen by the mixing engineer was still correct after all. Or - in the worst case - whether the whole song should be done again.

There should be sufficient risk-taking capacity within the recording phase and decisions should be made on the takes and tracks to be mixed. If the mixing engineer notices something exceptional during the mixes, he can, of course, contact the client and request a new track.

PICTURE 1. The vocal tracks of the first verse to be selected (Hiili Music 2020)

4.3   Comb out the extra tracks

During recordings, many technical things are tested with microphones and de-vices to get the wanted sound. Often many tracks are recorded from the same

sound source with a different set up. To avoid the number of tracks becoming unnecessarily large, the most experimental tracks can be pruned.
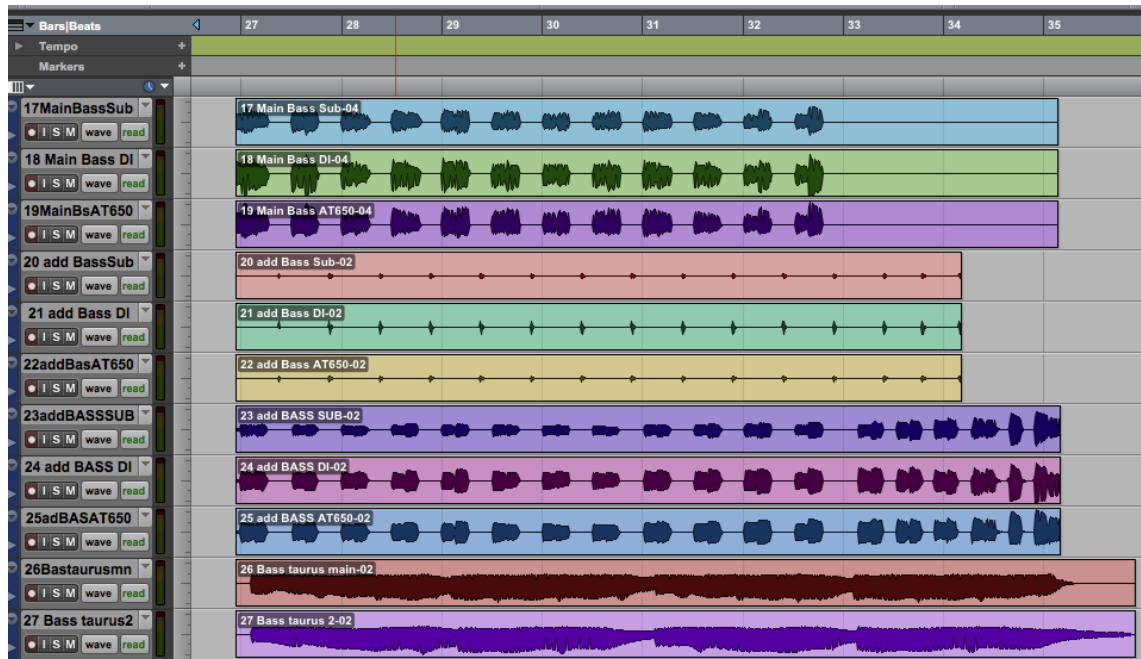
PICTURE 2. The tracks recorded with three different set ups (Hiili Music 2020)

The mixing engineer must work each track individually. During the recording phase, it may be noted that the total number of multitracks will not expand unreasonably. This frees up more resources to focus on the mixing itself.

4.4   Place the same sound on the same track

To avoid adding an unnecessary number of tracks, the same sounds should be performed on the same tracks throughout the song. The engineer can separate the parts for different tracks if the mix requires it.

4.5   Use clear track names

It is important to give clear names to each track. If this is not done, the engineer has to sort out what each track contains and arrange all the tracks. This takes an unnecessarily long time, especially if there are ten songs and each has dozens of tracks for example.
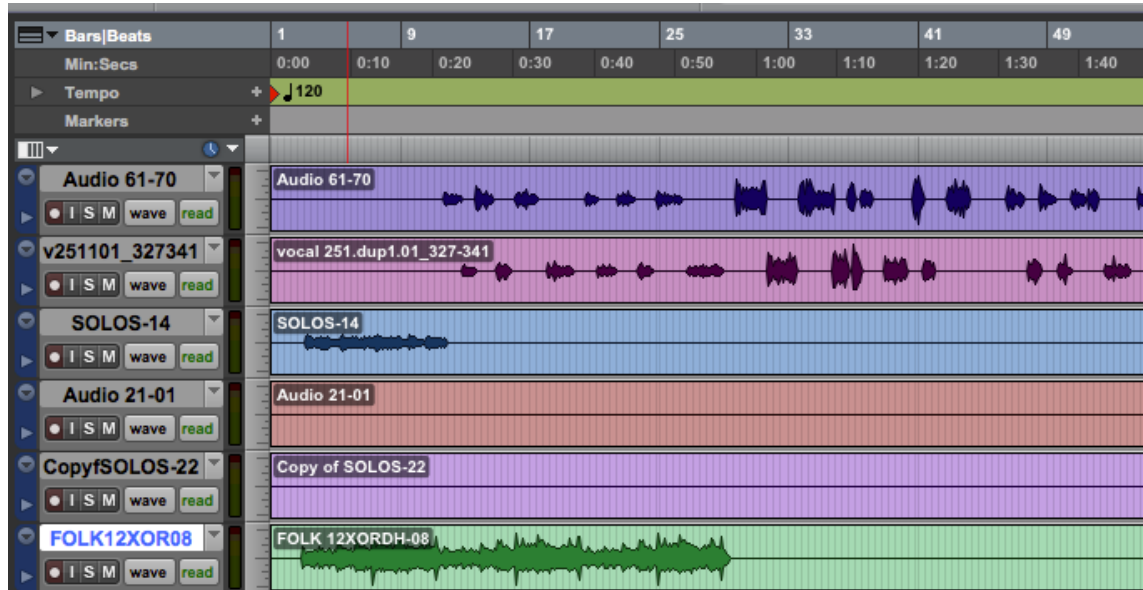
PICTURE 3. An example of incomplete track naming (Hiili Music 2020)

4.6 Write a number in front of each track name

A number in the front of track's name is important when opening the multitracks in DAW. When numbers are used in front of the track names, the tracks will open in logical order. If the numbers are missing, the tracks will open in alphabetic order. All the tracks must be placed in a sensible order before the actual mixing starts.
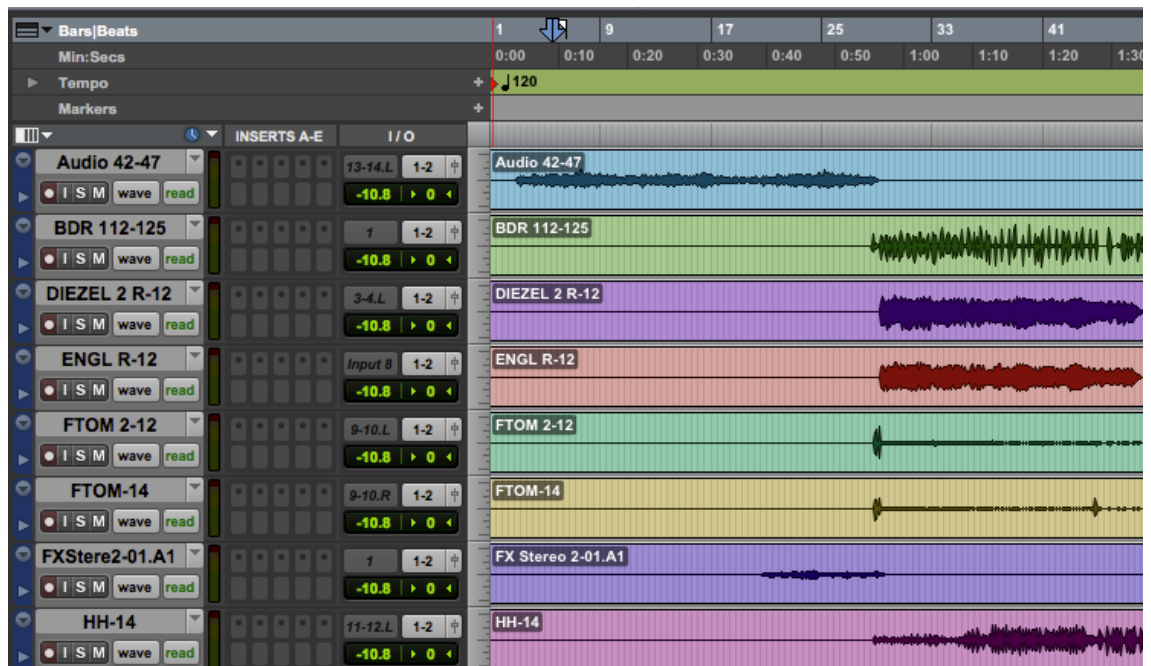
PICTURE 4. Alphabetic track order does not work properly (Hiili Music 2020)

4.7 Bounce all the tracks from bar one

It is crucial that all tracks are composed so that their starting points are the same. Each track should be compiled into a single track the length of the entire song. If this is not done, each clip will open in the engineers DAW at the beginning of the session, not at the spot where it was played.
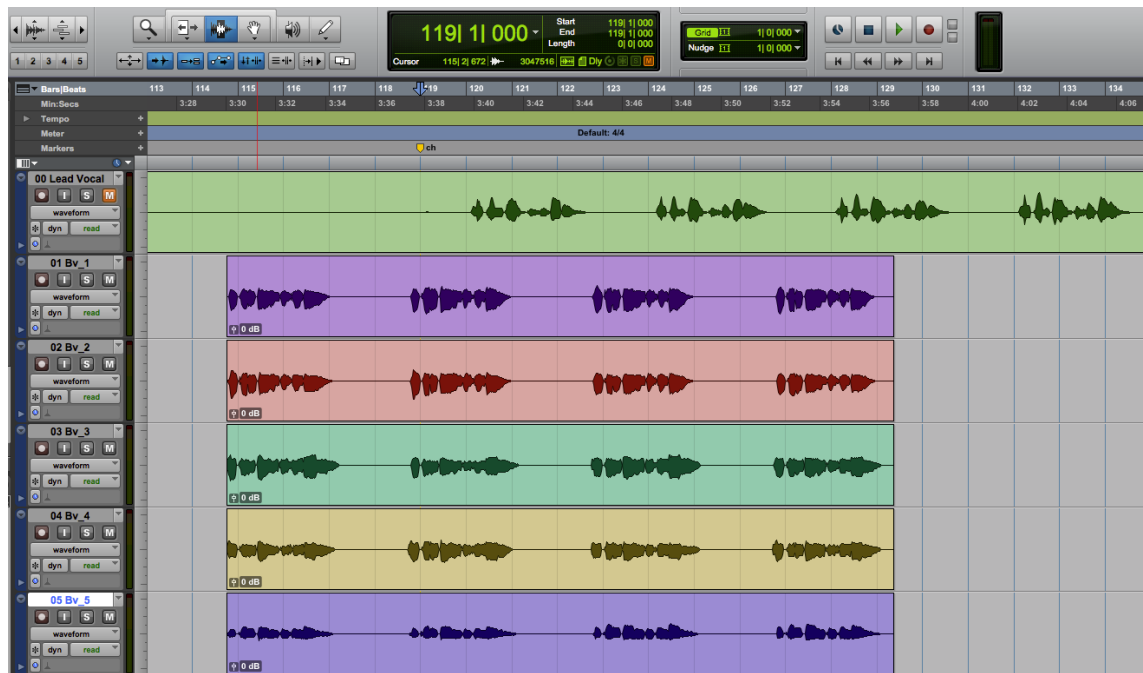
PICTURE 5. Backing vocal tracks are not matching with the lead vocal track (Hiili Music 2020)

According to Abbey Road Studios, you will need to provide multitracks that are consolidated or bounced from the start point of your song (bar 1 beat 1 or start time code). All files must be of the same duration, sample rate and bit depth. (abbeyroad.com 2020.)

4.8   Mono tracks and stereo tracks

When exporting the multitracks from DAW to be sent, mono tracks should be exported as mono tracks and stereo tracks should be exported as stereo tracks. The mixing engineer can can easily convert stereo tracks to mono tracks, but first you need to make sure the track is mono throughout the song. This takes a lot of time if there are dozens of tracks and there are many songs. The size of the files also increases unnecessarily, which slows down their upload and download over the network.

4.9   Print the special effects and ready sounds as audio

During the recordings many sounds can be created with plug-ins or with external effects devices like analog delays for example. If the created sound feels ready, it is worth to supply these sound tracks with the effect. For mixing engineer it is clearer and faster to use finalized track than trying to listen and copy the similar kind of effect from a rough mix for example.

"We ask that you to supply multitrack files dry, without reverb or effects. But, if you feel that a specific effect, processing or creative element (filter sweeps, delays etc.) is an integral part of the sound then please provide a clearly labeled 'dry safety' version of your track with-in your 'Reference Audio Folder' when you submit your project." (Abbey Road Studios 2020.)

4.10 Print MIDI tracks as ready-made audio tracks

One might think that the mixing engineer has comprehensive audio libraries with the best possible sounds and a huge variety of options. However, it is important that MIDI tracks are printed as finished audio. This allows the engineer to use tracks that follow the artist's visions. According to mixing engineer Kriss Walas, the most basic, and still the most reliable way to transfer virtual MIDI instrument tracks is to bounce each down as a continuous audio file, with all tracks starting at the same point (eg. bar 1, beat 1). That way, when you import the files into the other DAW, all tracks will line up as they should. (Walas 2015.)

Just in case, MIDI tracks can be delivered in their own folder or if the mixing engineer needs a MIDI track from a certain audio track, this may request that separately. It takes a considerable amount of mixing time to create sounds if there are multiple songs and numerous MIDI tracks. Creating sounds is more of a recording step than a mixing step where you want to mix the finished audio tracks together.

4.11 The click track

Digital devices have very accurate clocks. It is safer if a click tracks are converted to audio tracks in each song if click has been used in the recordings. To make mixing engineers work more fluent, it is good to name the click track with a beats per minute (bpm) number. If the click is played back from a separate drum machine, the click should be included as audio. Specially on older devices, tempo numbers are not accurate enough.

PICTURE 6. A click track can be very useful in the mixing (Hiili Music 2020)

4.12 Supply a rough mix with multi-tracks

To give a preliminary vision of the balances and pannings, it is illustrative to deliver a rough mix of each song and deliver it with the multitracks in the same package. According to an industry site Sweetwater.com, if a different engineer will be mixing the project from the one who did the tracking, a rough mix will be supplied by the tracking engineer as a guide for the mix engineer who may or may not use it as the basis for the final mix (Sweetwater.com 2017).

4.13 Supply all the multi-tracks at once

Nowadays recordings can be made in several locations. Musicians can work in their home studios within their own timetables. From client's perspective, it can

be tempting to deliver tracks to the mixing engineer little by little. Anyway, the multitracks should be supplied to the mixing engineer at once. Mixing does not proceed properly, if some of the multitracks are missing at the start.

From the mixing engineers point of view, it is important that the files are delivered in good order. To reduce the risks of mess, one person on the client side could gather all the recordings together and ensure that all the parts fit together seamlessly, both musically and technically before delivering the tracks to the mixing engineer.

For a special reason, surely, some tracks may be delivered retrospectively. If the release is in a hurry, for example, the mixing engineer can start making basic mix settings without a few tracks.

5   COMPLIMENTARY SOUNDS AND EDITING BY THE MIXING ENGINEER

In some cases the online mixing engineer can produce complementary sounds for the mixes. When preparing for the mixing stage, the mixing engineer should be informed of what kind of complementary sounds are desired or needed. As the mixing progresses, you may find that some tuning or timing could be a good solution. These edits affect the artistic outcome, it is good to agree on them as well in advance.

5.1   Drum samples

Depending a little on the genre of music, nowadays drum samples are used a lot. The mixing engineer can extract samples from the audio library and add them to the recorded sounds to enhance the overall sound. The mixing engineer can also completely change the sounds of the individual drums if the recorded signal is too weak for example. As stated in music magazine Sound on Sound's article, the performance might be great, but for the drummer having a rather limp kick-foot, for example, or it may contain inconsistent-sounding snare hits where the drummer's strokes are straying away from the centre of the drum (Dunkley & Houghton 2011).
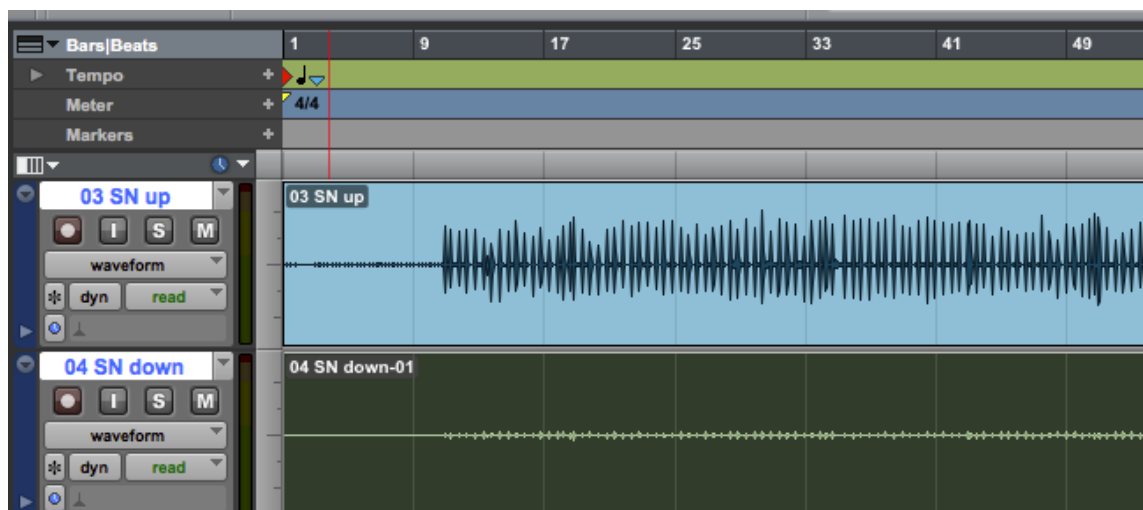
PICTURE 7. A sample can rescue a drum sound, if the original signal is too low (Hiili Music 2020)

The mixing phase in mind, it is a good idea to take sample sounds from the drum set already in the recording phase. This enables to use the original drum kit sounds if wanted. The samples can be used to amplify shocks played too lightly or to apply completely new shocks to places where they are not present in the original track.

5.2   Additional sounds

It is possible that completely new sounds are wanted to the mix. These can be sound effects or percussion loops for example. In such a situation, the client can be proactive and agree the case in advance with the mixing engineering.

5.3   MIDI sounds

It's technically easy to set sounds for MIDI tracks in a mix, but the artistic side is more challenging. There are dozens of options for just the basic piano sound. Since MIDI tracks do not contain audio, audio tracks corresponding to MIDI tracks must be delivered to the mixing engineer by the client at least as a demo. If the mixing engineer has to provide a more suitable sound for the mix than the original sound, one can use a MIDI track and provide the client with an alternative sound.

5.4   Re-amping

Re-amping is not actual mixing but recording. Despite this it is often the mixing engineer who runs the re-amping process in the studio conditions just before the actual mixing begins.

A DI-signal can be recorded to its own track while recording electric guitars and electric bass. In the recording situation the DI-signal can be routed to a guitar plug-in which guitarist finds good to play with. Then in the mixing process mixing engineer can use a re- amping box and re-amp the signal and make the ac-

tual recording. Nowadays, many other tracks are often re-amped than just guitars or basses.

PICTURE 8. Re-amping requires a special signal converter (radialeng.com 2020)

There are many benefits in re-amping method. A guitar or bass player can relax if one does not need to worry about the final sound during the playing. Recording DI-signal can be done without a noisy guitar amp. Because of that the recordings can be done easily in home environment or in a place requiring silence. The recordings can also be done faster, because final sound check or microphone set up are not needed.

According to guitarist and producer Nile Rogers, after he has done a performance that he thinks is the right performance, he can sit back and say, now let's try different amplifiers. That's an amazing sense of freedom to him (Rogers 2000, 179).

The guitar sound is extremely important and sensitive matter. It is crucial that the client accepts the re-amped sound before the actual mixing begins. Other-

wise, there is a risk that an otherwise successful mix will not be accepted due to the wrong sounding guitar. Re-amping is good to do before the actual mixing. Once the guitar sound is finalized first, the engineer can focus entirely on the mixing.

5.4.1 Re-amping with a real guitar amp

This method needs a real amp or amps and a microphone or many micro-phones. The sound is generated by a real amp, but it takes a lot of time to set up all the amps and microphones. If there are, for example, ten songs to be mixed and each one has several guitar tracks to be re-amped, the process takes a lot of working time which consumes the budget.

PICTURE 9. Setting up the amp system during the mixing process can be a laborious operation (Hiilesmaa 2012)

5.4.2 Re-amping with modular guitar amp

Modular guitar amps modulate real guitar amps, so their sound is high quality. The sound settings can be saved to an USB stick. Each guitar track has to be re-amped one by one which can take time.

PICTURE 10. A modular guitar amp allow to clone any guitar amp (Hiilesmaa 2020)

5.4.3 Re-amping with plug-ins

Re-amping with plug-ins is a quick and flexible way to handle the case. A plug-in is not a real amp which can be an emotional problem for some one. The plug-in is inserted in each DI-signal track. There is no need to record the tracks separately, but plug-ins play the audio in real time. This saves a considerable amount of time. Re-amping with plug-ins is the most cost-effective and very convenient option to re-amp. Like Rogers says about using plug-ins in re-

amping, "I hate to say it, but that's generally what I'm doing now" (Rogers 2000, 179).

5.5 Fine adjustments

The digital age has brought new tools alongside traditional mixing tools. DAWs are increasingly offering diverse tools for tuning and timing. Tuning and timing can be thought to belong to the mixing engineer. However, this should not be taking for granted. According to mixing engineer Steve Cruchyard, there is a danger in tune and time correction. Something perfectly in time, something perfectly in tune could be perfectly boring. (Crurchyard 2000, 129.)

5.5.1 Tuning

Sometimes a track may require tuning. For example, the bass track may contain small throws of tune or sometimes it can be badly out of tune. Backing vocal tracks may also require tuning to play well together.

Vocal tuning, for example, is much about art and there should be a clear agreement with the mixing engineer about tuning when preparing for the mixing phase. An audio engineer Brad Pack writes in Sonarwork's blog that timing and tuning can be subjective and it can be frustrating to go back and forth for these decisions that ultimately should have been made in the production stage (Pack 2020).

Depending on the style of music, the tuned sound may be highly audible or as transparent as possible. There are also styles of music and artists whose style includes a certain roughness. In this case, tuning is definitely an excluded operation. Vocals are so important element in music that some companies have found business that specializes only in vocal tuning. In large productions, the vocal tracks can be tuned separately by an engineer who specializes in tuning before the mixing phase.

5.5.2 Timing

When the multitracks are delivered to the mix, of course, everything is played and performed as well as possible. Like vocal tuning timing is about art and can be a very sensitive issue. Human groove versus mathematical timing. When preparing for mixes, the timing correction issue is good to go through with the mixing engineer. Which tracks should be fixed and how much. Some mixing engineers can have very strict vision about timing correction in the mixing phase. Pack says that one should not expect that the mixing engineer corrects timing problems. If there are any timing issues or transients that are off the grid, correct the problem before sending the session to a mixing engineer (Pack 2020).

Surely, when everything is put in place in the mix, some little inaccuracies may arise in relation to the timing. The mixing engineer may also use their own discretion and make some corrections.

6   PREPARING THE MATERIAL FOR ONLINE MASTERING

This section discusses in more detail what kind of measures and decisions should be completed when preparing for online mastering. A lot of individual songs are being released today. However, in this thesis the subject is approached from the perspective of an entire album.

Engineers David Miles Huber and Robert E. Runstein tell that the mastering process is an art form that uses specialized, high-quality audio gear in conjunction with one or more sets of critical ears to help the artist, producer, and/or record label attain a particular "sound" and "feel" for the finished manufactured product (Huber & Runstein 541).

6.1   Completed mixes

When sending the songs to be mastered make sure that the mixes are complete. In principle, it is conceivable to do the mastering first and then make further changes to the mix depending on what happens in the mastering. However, this can lead to back and forth activity and clearly increases the cost of mastering. If something is badly wrong the responsible mastering engineer will report it and request an updated mix. A producer Dylan Roth states firmly in Musician on a mission's blog that mastering is the final step in the production process and no one starts mastering until the mix is complete. (Roth 2020.)

6.2   The importance of the order of the songs

The right song order is crucial. The order must be submitted to the mastering engineer so that the engineer can compile the album. Sequencing the album is a challenging task and it should be done by someone experienced. The order of the songs is always a kind of compromise – surround songs often dictate the location of an individual song on an album.

A mastering engineer Bob Katz writes that the way the songs are spaced and leveled contributes greatly to the listeners emotional response and overall enjoyment of the album. It is possible to turn a good album into a great album just by choosing the right song order, though, unfortunately, the converse is also true. (Katz 2002, 87.) Freytag's triangle can be utilized in creating emotional response. It is used, among other things, in educational material for film production.
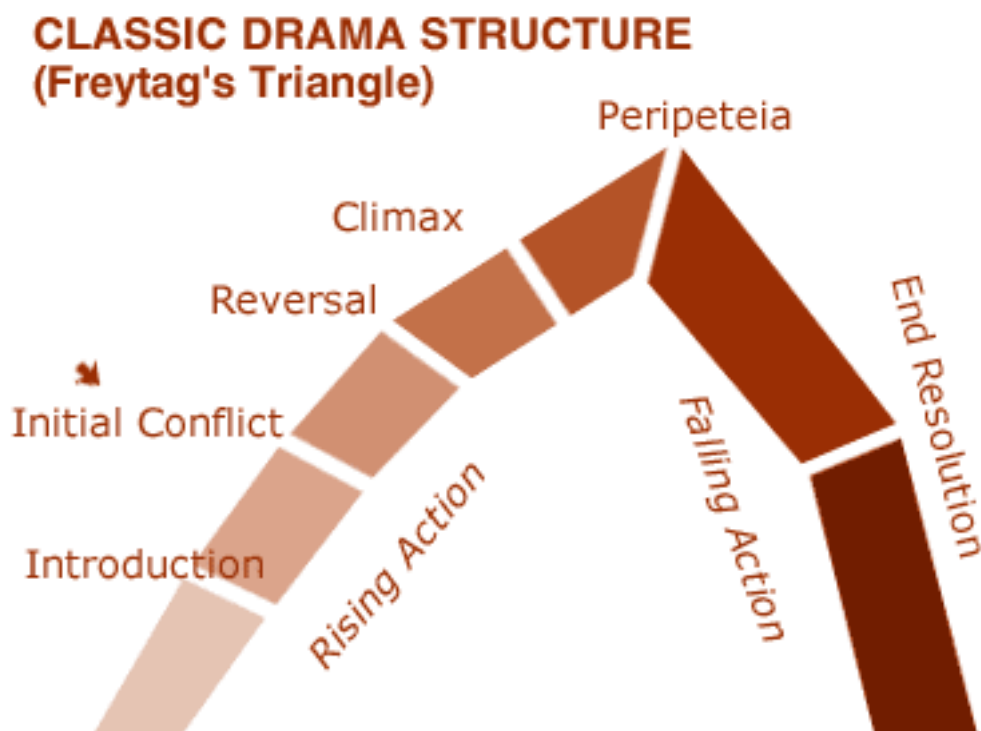
PICTURE 11. Model of classic drama 2020 (elokuvantaju.uiah.fi)

In principle, the mastering engineer could determine the song order. However, the mastering process usually takes only one day, so the mastering engineer can be too exterior to decide the order. Huber and Runstein say that choosing a project's song order is best done by the artist and/or producer to convey the overall feel of a project (Huber & Runstein 543).

Although vinyl releases are relatively rare today, many still think the album has A-side and B-side. Professor George Plaskens writes about singles that the A-side usually featured the recording that the artist, record producer, or the record company intended to receive the initial promotional effort and then receive radio

airplay, hopefully, to become a hit record (Plasketes 2013). This kind of approach can be a good practice and make it easier to arrange the song order for the other release formats. If the album has very different songs from each other, this method can make it easier for the listener to perceive the whole.

6.3 Working out the song order

A good start is to anchor a few key songs in position. The first song and the last song for example. A single or singles can be set among the first four songs. Less successful songs can be placed on the second half of the album. The first impression is important, the most successful songs are worth cultivating early.

When working out the order of the songs, a good way is to transfer the final mixes to the DAW and explore the song sequence before mastering. In DAW, it is simple to try different sequences and options.
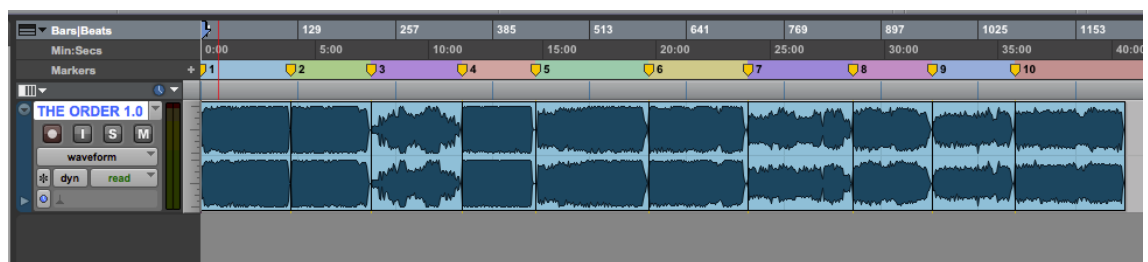
PICTURE 12. All the songs sequentially in one DAW session (Hiili Music 2020)

The beginning is very important. There can be a separate intro or a song that grabs the listener along. Like mastering engineer Bob Katz explains, the opening track is the most important, it sets the tone for the whole album and must favorably prejudice the listener. It does not have to be the hit or the single, but almost always should be up-tempo and establish the excitement of the album. (Katz 2002, 88.)

After three or four songs there may be a slightly longer space between the songs. Every third or fourth the song can be calmer material. This provides the appropriate dynamics and tension above. Katz continues, there are no strict rules, but usually the space between sets is a little greater than the typical

space between the songs of a set, in order to establish a breather, or mood change (Katz 2002, 88).

The last song of the album has to be selected carefully. It has to close the album in the right way, to make the drama of the album come true nicely. Katz says that the climax is obviously an exciting song that ends with a nice peak. This, followed by one or two easy-going songs to close out the album. (Katz 2002, 89.)

6.3.1 Different kind of songs

An album can have several different songwriters and they all might have songs of their own styles. There can be very different songs from each other. It is good if the songs of the same composer were scattered apart and not as a single cluster.

It's not a good idea to start or close the album with a song that is very different from the others. At the beginning it leads in the wrong direction and at the end it leaves a strange aftertaste. The best place is in the middle of the album, where it can act as a kind of watershed. One song may just not fit well musically with the rest. Eventually, we found a place for the offender near the middle of the sequence, as a one-song-set, with a long-enough pause before and after. It served as a bridge between the two halves of the album. (Katz 2002, 89.) Such problems could be avoided if the production is handled carefully for it is possible to record exactly the songs that form a functional whole.

6.3.2 Keynotes

When sequencing the album it is recommendable to keep the song with the same keynotes separated. The ears start to get tired more easily, if the same tunes are played for a long time compared to the tunes vary more. It is worth to

pay attention to the keynotes already in the earlier stages of production and making sure that there is sufficient dispersion in the them.

If the key does not change between songs, you may feel that the next song is the c-part of the previous one. Music school manager Chris Lambert writes that try not to put two songs in same key next to each other, unless you want them to sound connected. It can be hard to tell when one song has ended, and the next has begun. If you have to, consider fading out the first song. (Lambert 2018.)

6.3.3 Tempos

There should be enough change in tempo as the songs change. When selecting the right set of songs to production, it is good to note that the tempos of the songs are sufficiently different from each other.

6.3.4 Lyrics

It is about music and feeling when sequencing an album. So usually lyrics should not determine the track order. Katz writes that one musician thought it would be a good idea to order his album by the themes presented in lyrics. It was a musical disaster. (Katz 2002, 88.)

There are exceptions too. Like mastering engineer Karl Skivington notes, there are times where lyrics dictate an album sequence, the Rise and Fall of Ziggy Stardust and the Spiders from Mars was a concept album with the character committing suicide in the song Rock 'n' Roll Suicide. (Skivington 2017.)

6.4 Spacing the album

The lengths of the gaps can be left to the mastering engineer. However, the client may also have an accurate view of what the intervals should be. The al-

bum may also have crossfades where the end of the previous song partially overlaps with the beginning song. The correct space between songs can never accurately be estimated or counted, so putting an exact number on it is probably meaningless (Katz 2002, 90).

Usually fast songs run between shorter breaks to allow for intensity remains fierce. While after a slow or long song it works longer break. After the fade ends, a short break works. The very end of the fade most of the time drowns if the album is listened to in a car, for example.

The spaces can also be used as an effective remedy. Sometimes a special break can give good vibrations while sometimes a really long break can create a really dramatic feeling. The process of setting the gap times between songs can also make the difference between awkward pauses and a project that flows smoothly from one cut to the next (Huber & Runstein, 543).

Sometimes you can also try to define the spaces according to the rhythm. The beat of the previous song seems to continue and the next song starts with the right blow.

Spacing is also dependent on the mood of the producer and time of the day. If you space an album in the morning when you are relaxed, it almost always sounds more leisurely, than one which has been paced in the afternoon, when heats are beating faster. (Katz 2002, 90.)

6.5   Make a spacing demo for the mastering engineer

Song spacing can be very artistic and creative. In preparation for mastering, it can be helpful to make a demo of the spacing for the mastering engineer. If the client has a clear vision of how the gaps should be, the most illustrative is to make an entire album-long audio track with the desired spacing. That way, the engineer does not have to do the same job again or read visions from the cover letter. A mastering engineer surely reports to the client if anything suspicious occurs in the demo.
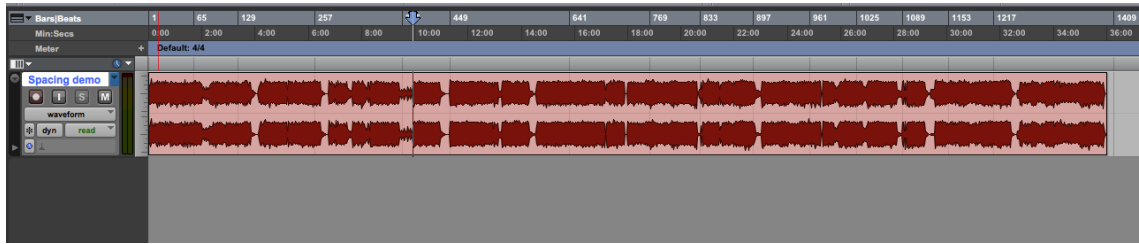
PICTURE 13. A demo of the gaps between the songs (Hiili Music 2020)

6.6   Choose the release format

When preparing for mastering, the release formats should be decided by the client. The client do not have to worry about the technical aspects of the different formats, but each format must be processed separately so they are priced differently. It is worth considering the budgetary implications of different formats and where the final products will be distributed.

DDPi - Download
£25 per format

Your tracks will be mastered for CD production and supplied as DDPi files to download. Max length 79 mins.

iTunes - Download
£30 per track

Abbey Road Studios is iTunes certified. Please supply 24bit master files.

Physical CD Masters
£50 per format

Your tracks will be mastered for CD production and supplied as either a PMCD or DDPi on a CD Master. Additional listening copies in bundles of 10 x CDRs available.

LP Album
£550 per format

Your tracks will be cut to a Long Playing Vinyl production master and supplied as Lacquer. Max length 20-25 mins per side.

12" Single
£450 per format

Your tracks will be cut to a 12" Vinyl production master and supplied as Lacquer. Max length 14-15 mins per side.

7" Single
£350 per format

Your tracks will be cut to a 7" Vinyl production master and supplied as Lacquer. Max length 6-7 mins per side.

PICTURE 14. Each format has a different price (abbeyroad.com 2020)

6.6.1   Digital release

Streaming services are one track-based platforms, no matter if the release is a full album. Because of this, the use of crossfades between two songs might not work. If crossfades are used, one song might break too early or the beginning of the next song might start too early. The streaming services offer a lot of playlists

with a mix of songs by different artists which is good to take into account as well.

The client has to supply the ISRC codes (International Standard Recording Code) to the mastering engineer. The most distributors offer free ISRC codes during the distribution process. You can still purchase ISRC codes if you'd like, but know that doing so is not necessary (Sageaudio.com 2018). Each code identifies a specific unique recording and can be permanently encoded into a product as a kind of digital fingerprint. (Dittomusic.com 2020.)

6.6.2 Vinyl record

A vinyl master is technically different from a digital master. There has to be another mastering for the vinyl and the client must indicate the division of tracks between side A and side B. Also, one has to keep in mind that a vinyl record is a physical record that can only hold a certain amount of music per side. Try not to exceed the maximum recommended playing lengths per side too much, as longer playing times will lead to a dramatic decrease in recording levels and dynamics (gzvinyl.com 2020).

6.6.3 CD

For a CD release there has to be a DDP file set for CD replication. The client can purchase the DDP player before the mastering phase. The player can open the DDP file and the client is able to check the spacing of the tracks on the CD and the exact points of the beginnings of the tracks. In addition to that ISRC codes can be checked before pressing the discs.
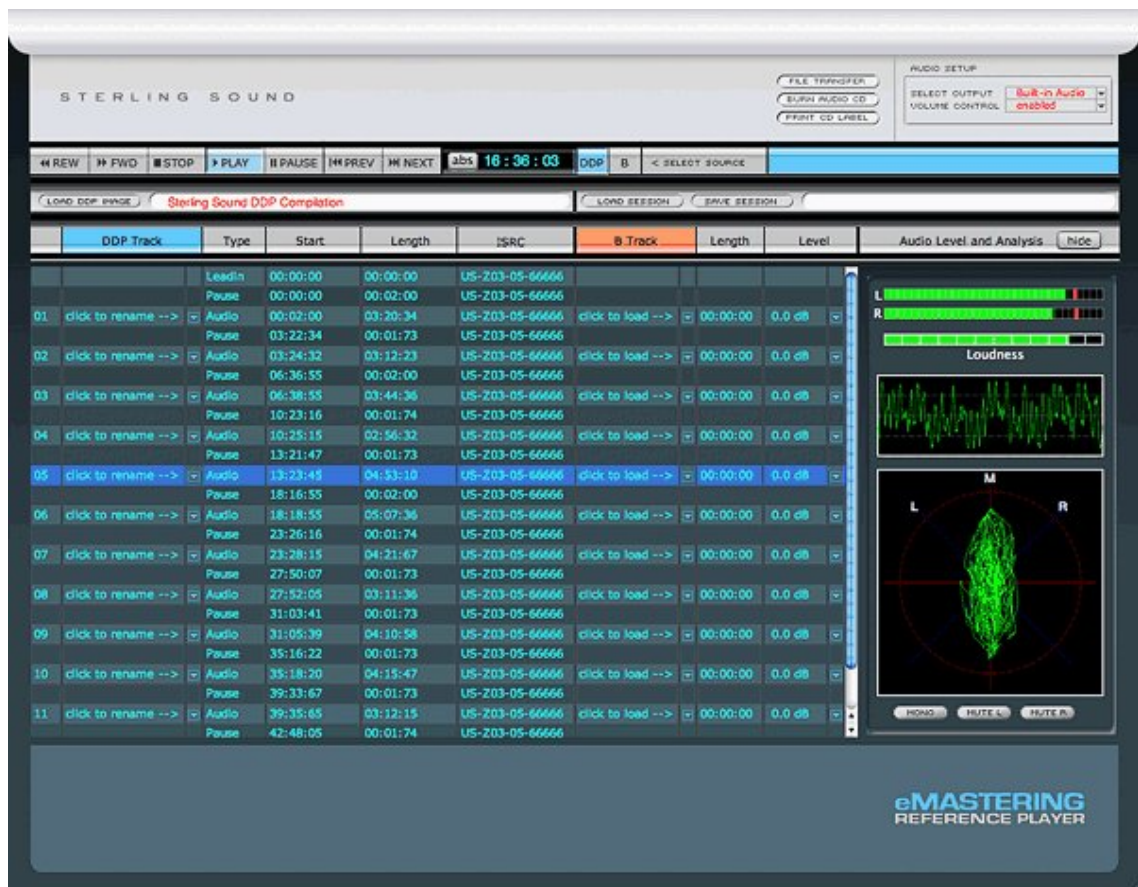
PICTURE 15. A DDP player displays a lot of information (audiofanzine.com 2020)

6.6.4 C-cassette

Like a vinyl record, a C-cassette has two sides. This must be taken into account when sequencing the songs to both sides. This format needs also its own mastering because of the analog tape. National Audio Company that prints C-cassettes tells that the material has to be re-mastered before printing the cassettes. "Re-mastering your audio for a cassette release is very important. The magnetic tape is a very sensitive medium. Level-dependent frequency limitations are common in analog mediums and there are so many other variables into making a cassette master that the artist and his mastering engineer cannot foresee." (nationalaudiocompany.com 2020.)

7   REFERENCES FOR THE ENGINEERS

7.1   Sound references for the mixing engineer

If the client provides references to the mixing engineer, it must also be stated what is exactly the point in them. An engineer Dylan Roth writes in industry site Musicianonamission.com that the point of referencing is not to exactly match every aspect of the reference track. The point is to have a guide that you can use to set you on the right path. Mixing is both a science and an art. There is logic and creativity inside every finished project. (Roth 2020.)

Artists may have a hope that the upcoming mix will be somewhat reminiscent of another artist's mix. When preparing for the mixing, it is good to tell what kind of wishes and what possible references the artist has in mind. Like Abbey Road Studios says, "In addition to as much written information as possible you are welcome to provide a rough mix as well as a commercially released reference song, as these will be useful as guides for the engineer" (abbeyroad.com 2020).

7.2   Sound references for the mastering engineer

Today it is easy to create a demo mastering by DAW of the final mixes. The demo mastering can demonstrate the overall level, stereo image or equalization for example. Some studios are willing to check them out, like Sterling Sound Studio. "If any pre-mastering listening references (compressors or limiters added to the mix buss for referencing at loud levels) were created after the tracks were mixed, please provide them" (Sterling Sound 2017).

8   TRANSFERING THE FILES

8.1   Use a common audio format

To make sure that a mixing engineer can open the recorded files, it is important to ensure a suitable audio format. Huber and Runstein guides that it is always wise to consult with that person about the general specifications of the final product before beginning the mixdown (or even the recording) process. For example, that person might prefer that the files are recorded and/or mixed at a certain bit rate as well as in a specific format. (Huber & Runstein, 545.)

To ensure that the mixing engineer can open multi-tracks, it is advisable to use the most common audio formats. In according to Abbey Road Studios, "We require WAV or AIFF files (44.1, 48, 88.2 or 96KHz)." (abbeyroad.com 2020.)

A mastering studio Sterling Sound gives same kind of instructions. The sources should be delivered as final Stereo or L & R WAV or AIFF files and should be 24/44.1 and up (Sterling Sound 2017).

8.2   Delivering the files

When files are delivered over the network, there is always a little risk that errors may occur. The album files can be larger than 10 gigabytes. If there is a suspicion that something may go wrong with uploading the files, it can be a good idea to first upload one song for trial.

Abbey Road Studios asks also to double check the audio files before uploading. The client should reload them into a new session and check that the files are the correct placement and length, Also it is important to check that every crossfades have been included when consolidating or bouncing in place. (abbeyroad.com 2020.)

Although the files are large, transferring the files to the engineer is simple today. There are plenty of free options available. Producer Michael Gallant writes on Discmaker.com that services like WeTransfer, DropBox, MediaFire, and Google Drive all allow you to efficiently share large files over the Internet and new services for transferring large amounts of data seem to pop up on a daily basis. Find one that seems stable and intuitive for you and your partners and give it a try. (Gallant 2016.)

In very large productions there can be a lot of material to be sent. If the material is tens of gigabytes, the material can also be delivered to the mixing engineer on an external hard drive by post instead of transferring them over the internet. Sending a hard drive from abroad also involves risks. If the files do not open properly, it is tedious to resubmit the files. In addition there is a small risk that the physical hard disk may be damaged or get lost completely in transit. The hard disk can also stop at customs in the case of a non-EU project.

9 CONCLUSION AND DISCUSSION

9.1 Evaluation of the study

Research on this topic revealed that there is very little material available on how to prepare for online mixing and mastering. Instead, there are a myriad of different tutorials where different levels of sound engineers share tips on how to mix or master. The emphasis is strongly narrowly on the signal processing side. Doctor Brecht De Man writes in his Degree of Doctor of Philosophy, Towards a Better Understanding of Mix Engineering that "research on the topic is challenged by a lack of suitable datasets, and consists primarily of controlled studies focusing on a single type of signal processing." (De Man 2017, 3.) This gives a thought that many engineers are more enthusiastic about new technology, equipment, and sound engineering. The other things, like productization and financial literacy, seem to receive less attention.

Initially, this thesis is aimed primarily at artists who record themselves and supply the materials for online mixing and mastering. However, this thesis provides at least as much information for professionals who do service design (Shostack) of their online services. The thesis can give ideas to determine the accurate delivery content, arrange the communication and plan the pricing. There are so many details in particular that the average self-recording client does not necessarily have to learn everything in advance, but can get the necessary instructions from online service provider who mixes or masters the product.

As Lukka (2000) states, the feasibility and practical functionality of a solution model developed in a well-conducted constructive research should also be tested and testing is one of the most important features of constructive research. The results of this study have been piloted in practice for multitrack delivery. The guide of this thesis was made available to those who have been Hiili Music's clients during the course of the study. The guide was also modified during the process based on the experience gained. In this thesis, ethical considerations were taken into account so that although the example cases were from different artists' productions, all the cases were treated anonymously.

9.2 Summary of the results

The materials delivered according to the guide have worked very well. Picture 16 shows a three song set of multitracks that are prepared by using the instructions of this thesis. Each track name has a number in front of its name, so the tracks open in logical order in DAW. Every set of multitracks have equal naming for the same sound source. The DI-signals of the guitar tracks are next to the amp sounds that makes re-amping process more fluent. Like the instructions guide, the key sounds are not MIDI but exported as audio tracks. The special effects, that are named as "FX" in the picture, are exported as audio tracks as well.
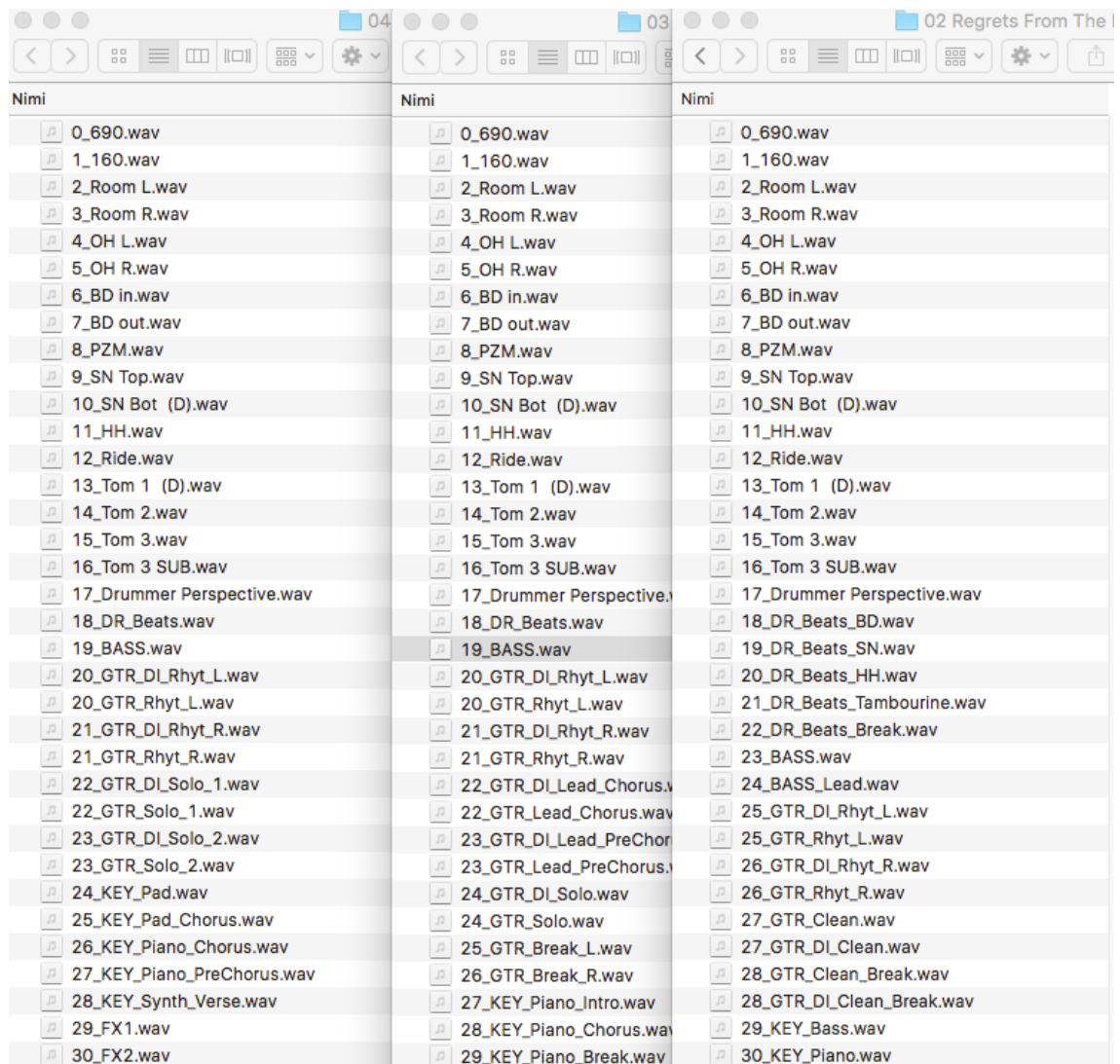
PICTURE 16. Multitrack sets of three songs (Hiili Music 2020)

As the Picture 17 shows, when numbers are used in front of the track names, the tracks will open in logical order, not in disordered alphabetic order.
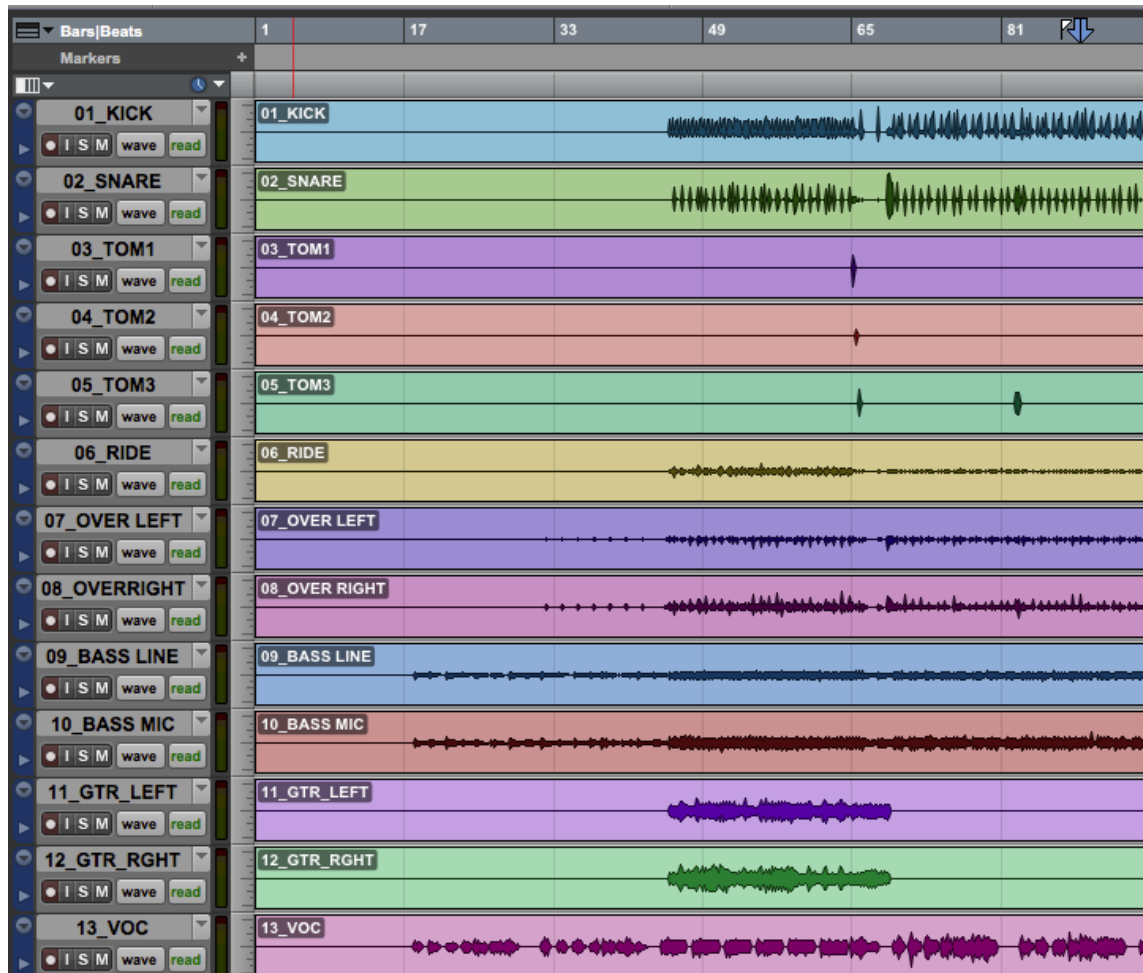
PICTURE 17. An example of clear track naming (Hiili Music 2020)

The instructions have streamlined the working process significantly. The technical problems and time-consuming interaction caused by their resolution have been reduced. The customer's funds have been saved and Hiili Music's working processes have become more efficient.

Problem areas related to the delivery of the material were also found. The recording phase may already be in progress when the online service provider is approached. However, it would be a good to have the guide available already at the recording stage. In this way, the points mentioned in the guide could be tak-

en into account in advance and the material processed accordingly. The earlier the client is in contact the better. It is also important that the guidelines are really followed, if one wants to generate savings and streamline the working process.

From the artistic point of view, there are a lot of small but significant artistic decisions that are good to complete before online mixing and mastering. For example, if the client is a band, it can be challenging to make some artistic decision. There can be major disagreements or uncertainty over artistic solutions. In this kind of cases the engineer can be given a lot of artistic freedom and one could serve as an objective and impartial referee. This kind of scenario allows the engineer to bring in more artistic input.

It is perfectly acceptable that not every client is skillful on the technicalities. However, it is so that the process is greatly facilitated if the client is motivated to learn and clarify some technical issues. The cases can vary a lot and it can be difficult to define the level of technical competence. Someone wants to record because he wants to learn technical things and is willing to do a lot of work for it. The other one may have to record oneself because it is the only option due to tight budget for example.

In some cases, the recording equipment could be acquired at the same time as the recording phase begins. The idea is to save the studio budget and buy your own recording equipment with those funds. In such a case, the risks of failure are elevated. It is recommended that before the actual recording one practices using the new equipment by making demo recordings for example.

The budget needs to be considered carefully in advance when preparing for online mixing and mastering. It would be worthwhile to make a determined and long-term plan, according to which one could achieve the desired goals. Based on their experience, the sound engineer is able to support to prioritize how the budget should be targeted reasonably, but such work can be very time consuming, especially if there are a lot of unresolved issues and several options still exist. This means more costs.

This thesis shows that interaction skills are emphasized when operating online. There are many different channels to communicate today. The conclusion of this thesis proves that the safest way to communicate seems to be e-mail. A telephone can work well in acute situations, but there is no document left in the conversations. Social media may be the most natural way for many to communicate, but it easily spills too much.

This thesis also brings up ideas on how the online service provider could develop his service. In the case of art things are often difficult to define. Cultural differences also emerge, activities are often international. Communication should be clear, consistent and relevant from both the clients and the engineers side. According to management consultant Jorma Sipilä, in some services, the ability to approach the client and communicate with one to find the right diagnosis is as important or even more important than having the expert himself have some technical solution ready for the client's problem. The analysis and solution are then produced in collaboration between the client and the expert. (Sipilä 1995, 72.)

It would be good for the service provider to have a separate module productized which could be directed to the clients who need more of the preparatory work. Such a product would benefit both parties and could also be economically viable for both. For the service providers there are many good tools available to help with service design. For example, Business Model Canvas (Osterwalder 2005) can help an engineer better identify one's own stakeholders and thereby target which products to focus on. The Design Ladder (Danish Design Center 2001) is also well suited for the development of the engineer's service which proceeds step by step as the service design progresses. Risto Siilasmaa, Chairman of F-Secure, reveals that he has had a habit of making lists with topics ranging from management thoughts, potential problems he perceives and various concerns. (2018, 159). It might sound simple, but requires self-discipline. Producing music is so multifaceted that I believe such lists are also useful in developing online service design and work in general as well.

9.3 Further developing suggestions

To support the guide in this thesis, a downloadable multitrack set is being pre-pared for the upcoming clients of Hiili Music. The set will include an examples of correctly prepared tracks to be transferred to online mixing and mastering. The set will serve as a support for a written guide. The example multitrack set can be downloaded to the client's own computer and one can see how the tracks open correctly in DAW. This supports to understand the preparation and the delivery process of online mixing and mastering even better.

REFERENCES

Abbey Road Studios. 2020. Official website. Read on 15.7.2020.
https://www.abbeyroad.com/help/is-it-ok-for-me-to-say-id-like-it-to-sound-like-insert-your-favourite-song-here-1013

Audiofanzine.com. 2011. Misc-music-software. [Guide]. Read on 24.7.2020.
https://en.audiofanzine.com/misc-music-software/sterling-sound/emastering/

Ballard, G. 2000. Behind the glass. Top record producers tell who they craft the hits. [Interview]. Interviewer Massey, H. San Francisco. Backbeat books. Copyright © 2000 by Howard Massey.

Crurchyard, S. 2000. Behind the glass. Top record producers tell who they craft the hits. [Interview]. Interviewer Massey, H. San Francisco. Backbeat books. Copyright © 2000 by Howard Massey.

Danish Design Center. 2001. The Design Ladder.

De Man, B. 2017. Degree of Doctor of Philosophy. Towards a better understanding of mix engineering. Read on 26.7.2020.
https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/25814/DE%20MAN_Brecht_PhD_Final_090517.pdf?sequence=1&isAllowed=y

Dittomusic. 2016. What is an ISRC code? [Blog]. Read 17.7.2020.
https://www.dittomusic.com/blog/what-is-an-isrc-code

Dunkley, J & Houghton, M. 2011. Soundonsound.com. Replacing & Reinforcing Recorded Drums. [Article]. Read on 10.7.2020.
https://www.soundonsound.com/techniques/replacing-reinforcing-recorded-drums

Filipetti, F. 2000. Behind the glass. Top record producers tell who they craft the hits. [Interview]. Interviewer Massey, H. San Francisco. Backbeat books. Copyright © 2000 by Howard Massey.

Freytag, G. 1894. Freytag's Technique of the Drama: An Exposition of Dramatic Composition and Art in 1894. Read on 15.7.2020.
http://elokuvantaju.uiah.fi/english/study_material/screenplay/ristiriita.jsp.

Gallant, M. 2016. Discmakers.com. Remote-collaboration-tips-for-sharing-music-tracks. [Blog]. Read on 17.7.2020.
https://blog.discmakers.com/2016/11/remote-collaboration-tips-for-sharing-music-tracks/

Gallese, V. 2011. 5 Neuroscientific Approach to Intersubjectivity. Embodied Simulation and its Role in Intersubjectivity. [Article]. Read on 14.7.2020.
https://pdfs.semanticscholar.org/2218/b0e1c9d86f63463defe58cd4724e7e144b9c.pdf

GZ vinyl. 2020. How to prepare a suitable master for vinyl. [Guide]. Read on 15.7.2020.
http://www.gzvinyl.com/getattachment/a310ba68-c81e-49d2-a51a-b87375f71cb4/How-to-prepare-audio-master

Hietanen, K. Psychotherapist. 2014. [Interview] 7.10.2014. Interviewer Hiilesmaa, H. Littered.

Huber, D.M & Runstein, R.E. 2005. Modern Recording Techniques. Sixth Edition. Copyright ß 2005, Elsevier Inc.

Ilonen, J. 2015. Stugor. TV programm. Producer: Onion, 2015. Part 3/10 Season 1. YLE Areena. Viewed 19.6.2020.

Katz, B. 2002. Mastering Audio: The art and the Science. Focal Press.

Lambert, C. 2018. Certain Sparks Music. How to sequence an album. [Blog]. Read on 3.7.2020
https://certainsparks.com/blog/sequencing-_album/

Lukka, K. 2000. Metodix.fi. Konstruktiivinen tutkimusote. [Article). Read on 23.8.2020.
https://metodix.fi/2014/05/19/lukka-konstruktiivinen-tutkimusote/

Moss, J. 2020. Behindthespeakers.com. [Blog]. Read on 1.7.2020.
https://behindthespeakers.com/7-steps-smoother-mix-revisions/

National Audio Company. Official website. 2020. No compromise. Re-Mastering for Cassette Tape. [Guide]. Read on 11.7.2020.
https://www.nationalaudiocompany.com/audio-services/re-mastering-cassette-tape/

Osterwalder, A. 2005. Business Model Canvas.

Pack, B. 2020. Sonarworks.com. [Blog]. Read on 20.7.2020.
https://www.sonarworks.com/blog/learn/how-to-prepare-your-session-for-a-mixer/

Perkins, J. 2020. Mystery Room Mastering. Official website. Read on 15.6.2020.
https://www.mysteryroommastering.com/attended-sessions/

Plaskens, G. 2013. B-Sides, Undercurrents and Overtones: Peripheries to Popular in Music, 1960 to the Present. Ashgate Publishing.

Radial Engineering Ltd. 2020. Official website. Reamp-basics. [Article]. Read on 18.7.2020.
https://www.radialeng.com/reamp-basics

Puurula, J. 2012. Mopolla Tähtiin: Äänitetuotannon realiteetit epärealistisessa tuotannossa. Bachelor's thesis 2012. Metropolia Ammattikorkeakoulu.

Rogers, N. 2000. Interview. Behind the glass. Top record producers tell who they craft the hits. Interviewer Massey, H. San Francisco. Backbeat books. Copyright © 2000 by Howard Massey.

Roth, D. 2020. Musicianonamission.com. The Real difference between mixing and mastering. [Blog]. Read on 27.6.2020.
https://www.musicianonamission.com/mixing-music/

Sage Audio Mastering. 2018. Official website. ISRC Codes Explained. [Blog]. Read on 7.8.2020.
https://www.sageaudio.com/blog/mastering/isrc-codes-explained.php

Shostack, Lynn. 1982. Service Design.

Siilasmaa. R. & Fredman, C. 2018. Paranoidi optimisti. Näin johdin Nokiaa murroksessa. Helsinki. Kustannusosakeyhtiö Tammi. © Risto Siilasmaa.

Sipilä, J. 1995. Asiantuntijapalvelujen tuotteistaminen. © Jorma Sipilä and WSOY.

Skivington, K. 2017. Music.tutsplus.com. The Art of Fades, Sequencing and Spacing an Album. [Blog]. Read on 24.7.2020.
https://music.tutsplus.com/tutorials/the-art-of-fades-sequencing-spacing-an-album--cms-29381

Sterling Sound Scheduler (S3). 2017. s3@sterling-sound.com. STERLING SOUND - Session Confirmation. E-mail. Read on 30.8.2017.

Sweetwater.com. 2017. [Blog]. Read on 23.7.2020.
https://www.sweetwater.com/insync/rough-mix/

Walas, K. 2015. A Licensed Continuum Music Studio Blog Creative Work. [Blog]. Read on 23.7.2020.
https://www.continuummusicstudio.com/midi-audio-secret-studio-success/