

# **The Use of Modelling Technology and Its Effects on the Music Industry**

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Bachelor's thesis  
May 2017  
Degree Programme in Media and Arts  
Music Production



## ABSTRACT

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Modelling technology has revolutionized the music production industry in a big way. It has affected everyone in the field of music production from the live side to the studio, both commercial and private. Even though modelling technology has been around in one form or another for twenty years or so, the last ten have possibly brought the greatest advancements. In this thesis, the goal was to map out some of these changes from several different points of view by interviewing four music production industry professionals and researching literature. The thesis project is a full-length album that was recorded almost entirely with modelling technology with the purpose of educating peers and people interested in music production of the possibilities that technology can bring.

The research yielded many compelling insights and points-of-view into the matter and gives a contemporary picture of a rapidly changing and growing industry. The interviews of four established professionals in the field of music production and their differing careers each give a unique perspective on the matter. They're all transcribed and translated in the appendices and they make for very interesting reading.

The thesis concludes that modelling technology, both software and hardware, plays a crucial part in all fields of contemporary music production. The interviewees and literature agrees on many advancements and steps forward, but there is also room for growth and some new challenges have risen.

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Key words: modelling, music production, software, hardware

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## ABBREVIATIONS AND TERMS

TAMK	Tampere University of Applied Sciences
Modelling	The practice of emulating pre-existing music production technology, amplifiers, instruments or other hardware with the use of digital processing in either virtual software, or hardware form.
P.A.	Stands for “Public Address”. A sound system usually consisting of microphones, a mixing console and speakers.
Preamp	An electronic amplifier that raises signal strength to a level that is required.
Compressor	A device used for reducing the dynamic range in audio.
Synthesizer	An electronic instrument that creates sound by synthesis, often by manipulating an audio waveform with different filters and envelopes.
EQ	Stands for “Equalization”. The practice of manipulating audio frequencies to for example reduce bass or treble for mixing purposes.
Control Room	The part of a studio where the producer or mixing engineer works in. Usually separate from the actual recording space in commercial studios.
Sampling	The practice of using recorded sound clips and files musically. Such as recording a drum beat, looping it or manipulating it for new purposes.

Tube Amplifier	The original way of amplifying for example guitars with the use of vacuum tubes, conventionally this is what guitar modelling technology tries to emulate.
Stomp Box	An effects unit. Uses and effects vary, but is mainly used on the floor by guitarists to add effects to the guitar signal.
Noise Gate	Generally used in mixing, but basically means that a sound signal only comes through beyond a certain threshold. Also, used by guitarists to eliminate interference or hum when not playing.
Wah-Wah	An expression effect for electric guitar, made famous by Jimi Hendrix.
A/D-D/A Conversion	The practice of converting an analogue electric audio signal into digital information and vice versa.
Chorus	An effect that is often reached by duplicating the input signal and delaying it slightly, this creates a “rich” sound.
Delay	An effect where the input signal is delayed and repeated to form a kind of echo effect.
Triggering	The practice of overlaying or replacing a drum hit in real time or in post-production with a pre-existing drum sample.
Vocal Comp	The practice of recording several vocal takes and combining them to reach a final edited take.

## 1 INTRODUCTION

Since the collapse of physical record sales, the music industry has been desperately trying to find its footing in a rapidly changing world. Profits at the big record labels have dwindled and the markets for recorded music have virtually collapsed in many other parts of the world (Kusek & Leonhard 2005, x). The changes in the music industry aren't, however, limited solely to the field of distribution and sales. The fact that many record companies are struggling financially, coupled with recent technological advances means that music is being recorded at home and elsewhere from studios more than ever. While many independent artists such as myself and other unsigned musicians with small budgets relish the idea of doing it all on their own in their bedrooms or rehearsal spaces, these changes can be catastrophic to professional studios. The revolutions in modelling technology mean that independent artists and producers can now own software and hardware that can successfully emulate almost any amplifier, microphone, preamp, compressor, synthesizer, effect or even a recording space, all at a more-or-less consumer-friendly price. In my thesis, I am going to delve into the concept of modelling, the advantages that it brings and the challenges that it presents.

I have been immersed in the world of music production for about half a decade now and a musician for twice as long. During these five years, I have built my own home studio for my own personal recording. Indeed, modelling is a matter I am closely acquainted with. While modelling affords us a world of seemingly infinite possibilities with a couple of clicks of a mouse or pushes of a button, it also presents us with interesting challenges.

In many cases I have found that limitations can fuel creativity, so what happens when musicians and producers are faced with the possibility of removing said limitations? Advantages can often bring forth new distractions as well!

## **2 EXPERT INTERVIEWS**

Because my thesis topic handles the use of modelling technology from an inside perspective, but also personal experiences and observation, I needed to reach out to experts in the field of music and music production. Furthermore, there are few published academic texts on the subject currently, most publications are in the form of patents due to the subject's commercial nature (Pakarinen 2009, 85). For the interviews, I tried to find experts from slightly different sides of the conversation, such as touring musician, retail, studio producer, songwriter, etc.

I kept my questions as open as possible so as to not lead the interviewees in their answers, and asked the same questions from each one.

### **2.1 Matias Kupiainen**

Matias Kupiainen is a Finnish guitarist, mixing engineer, mastering engineer and producer. He is best known for his work as the guitarist of Finnish power metal band, Stratovarius since 2008. He is also a part-owner of Helsinki-based 5 by 5 audio, a professional high class recording studio and has been working in the business for about fifteen years. (www.rockway.fi 2017.)

### **2.2 Jussi Kulomaa**

Jussi has been mixing professionally for over ten years and worked as a musician for over twenty years. He has a degree in music technology and as a longstanding employee or a music instrument retail store, has a unique angle towards the topic of modelling. (Kulomaa 2017.)

### **2.3 Hiili Hiilesmaa**

This is a man who needs no introduction when it comes to music production. Hiili owns his own production company and has clients in over ten countries. He has produced some of Finland's best known artists such as HIM and The Rasmus. Hiili also has a Bachelor's Degree in music production and frequently teaches at Tampere University of Applied Sciences. (Hiilesmaa 2017.)

## 2.4 Jem Godfrey

Jem Godfrey is an accomplished producer, keyboardist and songwriter. He's the founder, and one of my all-time heroes from the British progressive rock band, Frost\*. As a keyboardist, he has played on numerous tours, for example with Joe Satriani. While playing progressive music as a side project, he's supported himself and his family with producing and writing pop songs for over fifteen years. He has written songs for artists such as Atomic Kitten, Morcheeba, Shayne Ward and produced compositions for Blue, Gareth Gates, Ronan Keating, Samantha Mumba, Holly Valance among others. (www.frost.life 2017.)



### 3 HOW IS MODELLING AFFECTING THE INDUSTRY?

#### 3.1 At Home and In the Garage

Studio environment possibilities advance with contemporary technology. In the past, home and garage studios were mainly used for recording demos, so that musicians could record and remember their jam sessions and go back to the ideas they wanted to keep, and then refine them. (Hiilesmaa 2017.)

Nowadays you can see more and more mainstream albums, at least in the rock genre, that have been recorded at home or in a location that is not considered a commercial recording studio, Foo Fighters and Faith No More to name a couple. While Dave Grohl's (Foo Fighters) home studio nowadays happens to basically consist of gear from the now-defunct legendary Sound City studio, (therefore making it a bad example when it comes to traditional home studio budgets) this is still a relevant example never the less. After all, Grohl's garage was converted into a recording space for their album "Wasting Light", and was recorded before Grohl acquired any of the Sound City gear. (DiPerna 2011.)

Billy Gould's (Faith No More) studio, "Estudios Koolarrow" is the definition of a rehearsal-/jam space converted into an independent studio and is where the legendary crossover band recorded their latest album, titled "Sol Invictus". The album was also the first time that the band didn't use a professional mixing engineer from outside of the band, but rather opted to have Gould produce the album himself, with only some help from beyond the band. (Frost 2015.)

Another good example is the Finnish artist's, Anssi Kela's eponymous 2013 album, "Anssi Kela". The album was recorded entirely by Anssi himself on his macbook laptop and went straight to the second place in the Finnish charts. Anssi recalls using extensive modelling especially when it comes to synthesizers, stating he used Arturia's synth package presets for most synthesizer parts, only tweaking slightly when needed. (Pa-lopiski, 2013.)

As a musician and production student myself, I've come to notice a growing phenomenon in the independent music scene of my hometown, Tampere Finland. It seems like everyone in a band nowadays has recording gear of some sort, or at least knows someone that does. Many of my friends' jam spaces have at least some form of acoustic treatment and a microphone setup of some sort, disregarding the PA. Of course, the level of know-how regarding the use of said gear and its quality varies greatly, but just like in the past with cassette recorders, pretty much everyone knows how to press "record". Below you can see a picture of my messy living room/home studio in Figure 1.

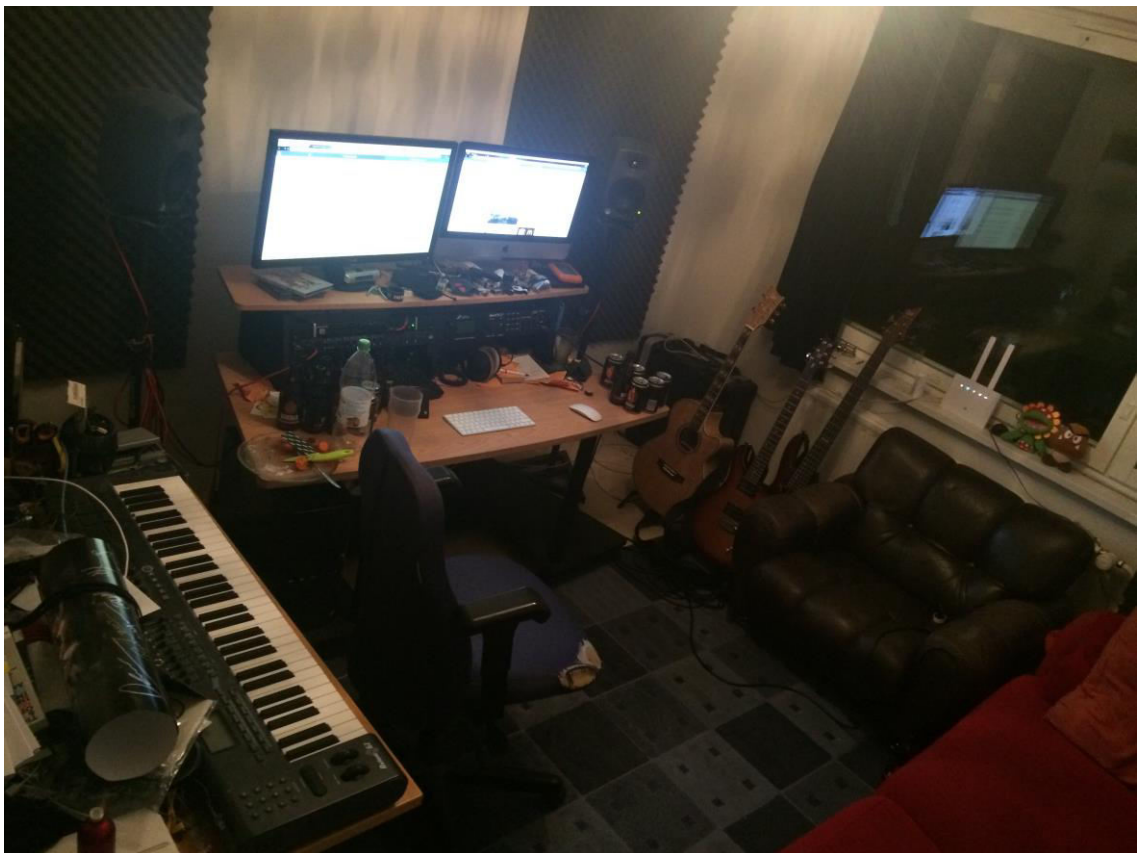


FIGURE 1: My home studio (Photo: Viljami Wenttola 2017)

The transition into modelling can be seen clearly on the retail front as well. Independent musicians don't usually have a loading crew, so the easier it is to load their gear from rehearsal space to performance venue, the better. Even the "tube tone purists", the people that up until now have sworn for "the real thing" sound-wise, are starting to get interested in modelling gear. (Kulomaa 2017.)

### 3.2 In the Commercial Studio

In a commercial studio environment, there are a different set of priorities. Decisions that are made must always consider the business side of things. Even though the line between home studio and commercial studio may blur sometimes, if you make a living off doing what you do, it's probably important for you to keep your head above the proverbial water. (Kupiainen 2017.)

Based on my experiences with commercial studios and my interviews with music production professionals, it's beneficial to keep an open mind about modelling, it may save you money and time in the long run. While many professionals keep original hardware, it's usually at the stages where it either matters to the customer, or where modelling still has a way to go. Also, for some customers, it may be attractive and desirable to book a studio with original hardware like the SSL 4056G+ Special Edition mixing desk as seen below in Figure 2 which was taken from the control room of the previous location of 5by5 Audio.



FIGURE 2: The old control room of 5by5 Audio (Photo: [www.5by5.fi](http://www.5by5.fi) 2017)

“With modelling, you can for example change the sound drastically at the blink of an eye compared to building a different set up each time.

You can go through different alternatives in a short period of time, this saves money, money that can be used on other important costs. This is one of the core objectives of being a music producer.

It's more enjoyable to use original gear if the songs have few tracks, this is because the original gear may deliver more randomness. The original gear can at times hum and “brum” in a completely unique and non-modellable way.” (Hiilesmaa 2017.)

### 3.3 Why now?

Modelling technology in the world of guitar has been available for some twenty odd years now, but among the industry, has never been held up to scratch when it comes to quality of sound, until now that is. (Kupiainen 2017.) While the prevalence of the “buzz saw” type of guitar distortion and Hi-Gain overdrive heard for example in the Swedish death metal scene meant that some people were distinctively going for edge and hyperbole, the modelling tools of the past always fell short of achieving the subtleties of actual tube driven guitar amplifiers. (Shrum, T. 2015.)

When it comes to drums, drum samplers have been around since the early 80’s and in the early days were clunky hardware sequencers with built in sound banks. In the early 2000’s though, the “Drumkit From Hell” arrived onto the metal scene. One of the first drum sample packages detailed enough to even get close to sounding like an actual drummer, at least in the dynamic-squashing overly processed world of extreme metal. The Drumkit From hell was originally made by sampling Thomas Haake’s drumkit into an extensive sample bank which in this scale had never been seen before. This was done for Meshuggah’s 2005 album, “Catch Thirtythree” because of artistic reasons as the album kept changing greatly during the recording process. (Begrund, A. 2005.)

Since the days of the “Drumkit From Hell”, technological advances have hit the world of drum sampling hard. With a range of samplers to choose from, such as the Superior Drummer which I use in my thesis project, the sample libraries are bigger, more detailed, with different mic configurations, higher definition audio etc. Meaning in this day and age, if you’re willing and able to put in the time and care, you’re able to bypass the need of an actual drummer. (Greeves, D. 21-22. 2015.)

So why now? Why are we starting to see an increasing number of top-of-the-line musicians use modelling instead of the real thing? The short answer is two-fold: the increase in processing power and research. Instead of listening to what’s coming out of the speaker of the great sounding tube amplifier and trying to replicate that, people have been looking into the circuitry and the intricacies of what’s going on inside of the mechanism that they’re trying to model. (Kulomaa, J. 2017.)

The fact that we can get very close to the actual sound of the originals that we're trying to replicate, with taking up a fraction of the space than the original, means also that touring musicians are saving money and nerves on the road. Every extra kilogram that you must carry on a plane costs extra money, and money talks. Also, on tour you're faced with a wide range of different kinds of venues, so the fact that you can get the same guitar sound day-in-day-out without having to find just the right microphone placement of a guitar cab is a huge advantage since modelling processors such as the Axe-FX (seen below in Figure 3) and Kemper can be fed straight into the line input. So even though you're making a very small compromise in terms of the final sound, it's such a small one these days that it's worth it. (Kupiainen, M. 2017.)



FIGURE 3: The Fractal Audio Axe-FX II XL+ (Photo: Viljami Wenttola 2017)

## 4 HOW MODELLING WORKS

### 4.1 Guitar and bass

There are two main type of guitar and bass amplifiers, the transistor- and the tube amplifier. You'll find the former mostly in effects pedals, stomp boxes and in combo amplifier solutions where the speaker cabinet and the actual amplifier head are both in the same package. (Gallagher 2012, 85-86.) However, in my experience, it's the latter that people mainly go for when we're talking about modelling pre-existing electric guitar sounds. Hence, I will be focusing on the modelling of tube amplifiers in this section.

The actual intricacies and detailed processes of modelling guitar sounds are very complex, to understand the whole process one must understand complex functions, waveshaping (a method for obtaining signal distortion by nonlinear mapping of input and output variables) and electronics (Pakarinen & Yeh, 2009). Because I am not an expert in any of those fields, I will explain the process in layman's terms. There are different patents and methods in place by different companies such as Yamaha and Line6, a scheme by the latter can be seen below in Figure 4.

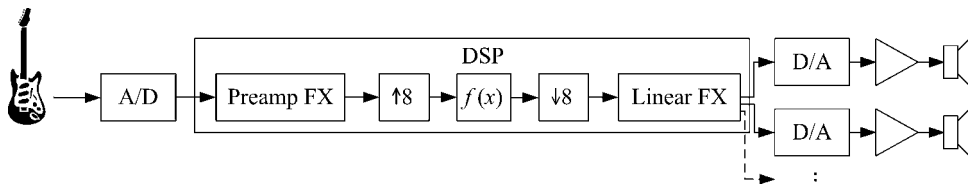


FIGURE 4: Tubetone Modelling schematic by Line6 (Photo: Doidic et al. 1998)

Basically, the signal from the guitar is converted into digital information by the A/D converter, it is then fed into some preamplifier effects, for example noise gate, compressor or wah-wah, then the actual modelling happens. In this case, the signal first goes through an eight-time oversampling circuit (this is to do with the sampling rates and differs from the Yamaha patent) before the actual modelling taking place, then the signal is downsampled back to 31.2 kHz before the linear FX such as chorus or delay and finally is fed to the speakers after the conversion D/A conversion. (Pakarinen & Yeh, 2009.)

In broad terms, all guitar modelling works more-or-less in similar ways, the signal is converted from analogue signal into digital, is then processed in the unique way that that manufacturer has developed, is then converted back to analogue signal and the more processing power available, the more possibilities there are. Even though usually it means modelling a tube amplifier, the process would be the same for modelling for example an existing transistor bass amplifier.

What sets the modelling technology of today apart from that of the past, is the processing power and variables that the manufacturers are able to take into account. Manufacturers can map what is going on inside the amplifier, the components and how it is built, take all of it into account instead of merely what kind of sound is coming out of the speaker. Nowadays they can even model what kind of microphone is supposedly picking up the sound of that supposed cabinet. (Kulomaa, 2017.)

There are however still ways how the technology can be made better. Even though the compromises that guitarists must make are getting smaller and smaller, the players are also getting more demanding. For example, one way the technology of guitar modelling can still go forward is to consider the air between that modelled cabinet and microphone, as it always affects how we hear what's going on. (Kupiainen, 2017.)

## **4.2 Drums**

Drums are modelled in a different way than for example guitars. This is done by sampling. Nowadays the most popular sample based drum machines, for example, EZDrummer, Addictive Drums and Superior Drummer are all flagship examples. They're basically just massive sample packages with their own graphical user interface. It depends which package you're going with, and many drum machines have a plethora of expansion packages, but basically, you're dealing with industry standard drums and cymbals recorded in famous studios with famous microphones. (Greeves, 2015.) They often come with their own set of preset grooves libraries, but later in the thesis project part I demonstrate how I am accustomed to using them in my own music.

### 4.3 Virtual Synthesizers

Synthesizers have been around since the early 70's in all shapes and sizes, but have undergone a major revolution with the digital age. As processing power increases, we're able to achieve impressive sound synthesis feats in real time with virtual synthesizers, and instead of lugging around a rig of four to five hardware synths, you'll see more and more musicians nowadays with their macbook laptop on stage with one or possibly two USB MIDI controller keyboards. (Kulomaa, 2017.)

The way virtual synthesizers work is very similar to their predecessor counterparts, but instead of having a big physical piece of hardware with its own dedicated processor within, the computer does the processing and the graphical user interface shows you where to click. (Kulomaa, 2017.) The program/virtual synth creates a sine wave (or the kind of wave depending on the sound) and applies envelope filters, LFO's and effects to it just like a "real" synth would. In my thesis project, I use virtual synthesizers to achieve Hammond and Mellotron styles as an example.



## 5 THESIS PROJECT

### 5.1 About the Project

On December 31<sup>st</sup> 2016, after the dissolving of a prior band, I decided to form a new band in the form of a solo project called “Joviac”. While in time the plan is to form a full-fledged band with real musicians, it was important to me to get the ball rolling and to take care of the song writing, as well as the production on this debut album myself. The album will have its digital release in May, and will be distributed to the appropriate streaming services through Music Kickup, a Finnish company that specialises in services for independent artists and bands (Ilta-Sanomat 2015). I enlisted a very talented friend of mine, Antti Varjanne from the Jyväskylä-based progressive metal band Cønstantine to play bass. I took care of everything else, including but not limited to song writing, arranging, singing, playing guitar, synths, programming drums, mixing, producing and mastering. All in all, this album is the true definition of “labour of love” and I am immensely proud of it.

I feel that the album is a very good example of how modelling technology can be used to an independent artist’s/band’s advantage when faced with limitations for example regarding band members and lack of recording space. As a personal example: it may be difficult to find a good drummer willing to join your band and session musicians can be expensive, so to get your music out there it may not be a bad idea to invest in a decent drum machine (Greeves, D. 2015). Indeed, modelling is used in all aspects of the album, from guitar amplifiers to mixing plugins.

### 5.2 The Process

I began writing the album in August of 2016 and four months later I had an album’s worth of material, seven songs to be precise. The plan was to record basically whatever material I could come up with into demos, without too much scrutiny or censorship. What came out was not surprisingly rock and metal music that was progressive to a degree, but what I didn’t anticipate was the amount of dynamic range in the songs.

In the song writing phase my method of choice is to record everything into Logic Pro X as demos. Logic is a brilliant DAW for composing and demoing, as it offers easy and quick access to many tools that make the process intuitive (Bustelo, D. 2014). However, I chose to do the actual recording of the album in Pro Tools as that is the DAW I am most familiar with. Once I come up with a riff or melody, I instantly get a feeling of what part of a song structure it belongs to, and I start fleshing out the idea from there. If I run into writer's blocks I leave that particular song to "ferment" and come back to it later, sometimes years later. Once I had an album's worth of song demos that I felt were good enough and formed a kind of cohesive "wholeness", it was time to arrange them into their more-or-less final forms.

### 5.2.1 Drums

During the demoing phase, I use Logic Pro X's Drummer a lot. It may not always give me quite the beat that I'm going for, but as it is important for me in the song writing phase to have fast and intuitive tools to take advantage of your creative flow, it's often close enough for the time being. With different kinds of parameters for each preset beat, "loud", "soft", "simple" and "complex", you can drag the point in the matrix (as seen in Figure 5) to wherever you feel like. Also, the "follow" option allows the drummer (in this case "Jesse") to "listen" to a channel of your choosing to try and match what it hears. This functionality is often quite hit-or-miss, especially when it comes to more complex song parts, but has on many occasion offered interesting and unexpected approaches to my guitar riffs. Once I am in the arranging phase, I drag the Logic Drummer clips onto an adjacent MIDI track, this converts them into MIDI blocks instantly with corresponding dynamic velocity in each drum hit. Then I fine tune the drums into exactly the beats that I want. If you're going for a result that sounds as natural as possible, it's advisable to pay attention to the velocity of the drum hits and therefore the MIDI notes. The fact that the Drummer offers by default in the blink of an eye makes the programming a lot swifter. This makes for more realistic sounding fills especially with ghost notes to boot. (Albano, J. 2015.)

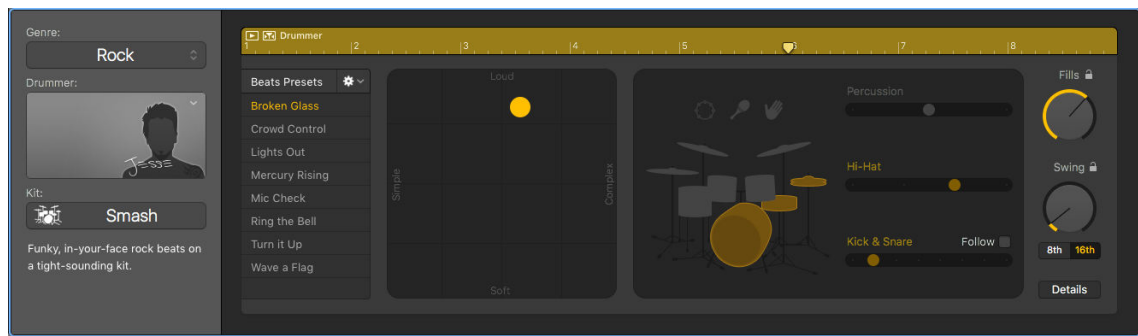


FIGURE 5: Logic Pro X Drummer interface (Photo: Viljami Wenttola 2017)

Once the drum MIDI track is final, it's time to export it out of Logic and into Pro Tools. In Pro Tools, I use a more extensive drum machine called Superior Drummer (which can be seen in Figure 6). The reason for this is that it allows me to choose each separate drum and cymbal depending on my preference, to bounce files out of the plugin depending on the mic configuration that it's simulating and to control the bleed of each mic (Greeves, D. 2015). In an actual real drum recording situation, I would strive to remove as much of the bleed as possible in the mixing phase, so in this situation I removed bleed from all the microphones all together except from the ambience microphones. Each microphone now exclusively picks up the drum that it is supposed to, and the overheads only pick up the cymbals. Once the files are bounced out of the Superior Drummer plugin, I can import them into my Pro Tools session just like real drums. From this point on, the experience is just like working with real drums, except easier because of no bleed. It should be noted however, that the MIDI mapping in Logic's drum kits and in Superior Drummer are slightly different, so one should be thorough and check the tracks before bouncing.

Because we are working loosely within the genre of metal, I chose to "trigger" the kick drum and the snare drum. The reason for this is that even though I am working with machine drums, the tracks still contain a fair amount of dynamic range in terms of hitting velocity, but in this genre, I really wanted to go with an explosion of sound especially when it comes to the snare. One could argue that I could have just addressed this at the programming phase, making every snare hit as loud as the other, but as a personal preference, this is the route I chose to get the sound that I desired. I experimented with triggering the toms too, but concluded that they sounded better "au naturel". The plugin used for triggering in this session was Trigger 2 by Slate Digital. (White, P. 2010.)



FIGURE 6: Superior Drummer’s interface (Photo: Viljami Wenttola 2017)

## 5.2.2 Guitars and Bass

Guitars are at a very integral role in my music as most of the song writing happens with guitar in hand. In the winter of 2016, when still writing the songs for the album, I could finally after years of dreaming, purchase the Axe-FX II. Even though the possibilities guitar-wise with this hardware are nearly endless, I found my desired guitar sounds from the presets almost instantly. All the rhythm guitars are recorded with the preset patch “Petrucci Rhythm”, which is modelled after the Dream Theater guitarist, John Petrucci’s rhythm guitar setup. It consists of a USA IIC+ Brt/Dp amp head which is modelled after the Mesa/Boogie amp of the same name, and a 4x12 cabinet with V30 speakers (Fractal Audio Axe-FX II Wiki).

If I had been unsure of the exact sound that I wanted to go for, I could have also recorded the guitars straight into my external audio interface’s (Apogee Element 88) line input and “reamped” them later through the Axe-FX (Fractal Audio Axe-FX II Wiki). This is a method that we would opt for with the previous band. We’d use the EZMix 2 plugin

for just a preliminary sound, pick a reference and send the tracks to a friend who owned the Axe-FX for reamping. The second I heard the Petrucci preset though, I was set.

All of the rhythm guitars are quad tracked, meaning that they're all recorded four times and panned hard left and hard right. This is done to give the guitars a heavy, "wall of sound"-type effect (Zak. 2001, 77). The guitars were recorded first twice with the basic Petrucci Rhythm preset, and then the same tracks twice more except with an Ibanez TS808 tubescreamer pedal model engaged. The tubescreamer tracks are then mixed slightly quieter than the first tracks and all go through the same auxiliary channel. It's very important to get four takes that are as identical as possible so you do not end up with a sloppy, undesired effect (Stafford, A. 2015). Needless to say, to achieve four identical tracks, I had to record a great number of takes. However, this is the best kind of technical practice for guitar that I know, because you are instantly shown your weaknesses.

For the lead guitars, the sound is very similar but with more effects such as delay etc. all of which come straight from the Axe-FX. There are no effects added onto the guitars in post-production. I chose this method to reduce CPU strain on my iMac, to synchronize delays, it was a simple matter of manually altering the delays' tempos within the Axe-FX.

It was originally my intention to reamp the bass tracks through the Axe-Fx as I was not sure of the bass sound I wanted to go for initially, and as nowadays there are very good bass amp models included right out of the box (Fractal Audio Axe-FX II Wiki). However, while I was doing preliminary mixing for the album, I concluded that the initial sound of the Spector Legend 5 Classic bass itself was so good that this was not needed. Instead what you hear is the line input sound of the bass, with all its active EQ knobs on full and some slight mixing plugins for a bit of distortion, contour and equalizing.

### **5.2.3 Vocals**

There are a lot of vocal tracks on this album. Aside from the lead vocal tracks and overdubs, there are multiple songs that have choir parts with 6-9 voices, as seen below as the highlighted tracks in Figure 7.

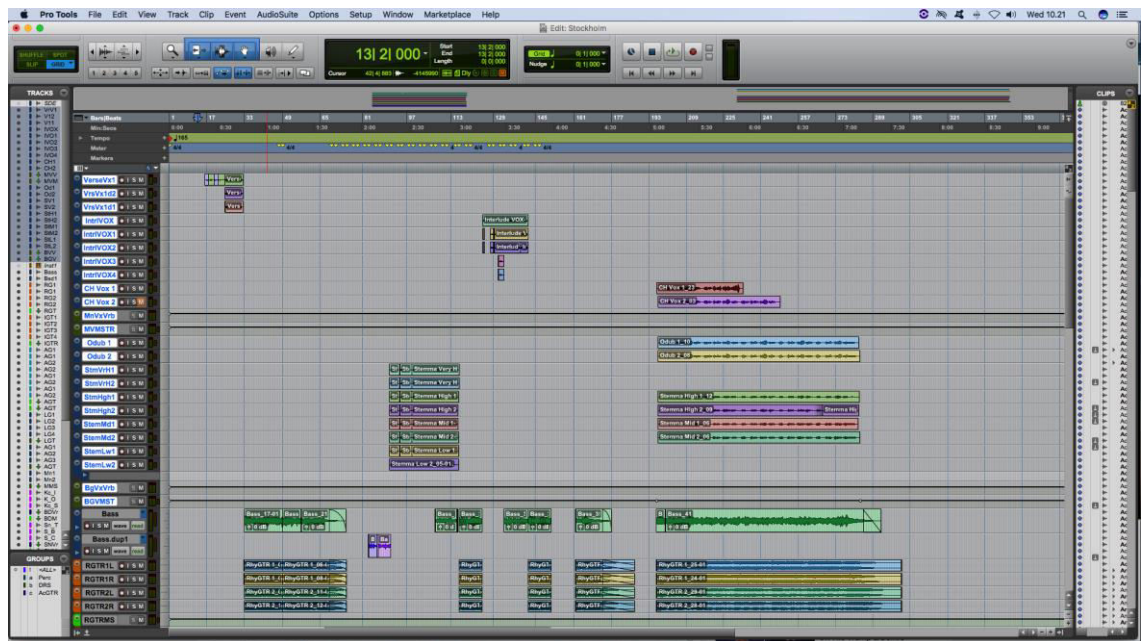


FIGURE 7: A screenshot from the song “Stockholm” off thesis project album (Photo: Viljami Wenttola 2017)

I was given a chance by TAMK to try out a new bit of gear for vocal tracking on this album, The Virtual Microphone System by Slate Digital. This software+hardware combo gives one the possibility to emulate a wide array of classic tube microphones (Rogers, N 2016). I had to do a lot of comparing between the different microphone models because they all sounded great, but ended up going for the “FG-M7” (shown in Figure 8) model as I felt it suited my voice the best.



FIGURE 8: The virtual signal chain on the lead vocal on the track “Battlefield” off the thesis project album (Photo: Viljami Wenttola 2017)

I did about three months of work placement/training for my degree at Cosmic Studio for producer Markus Seppä and there I learned an efficient way to track vocals. When it comes to lead vocals, I record and save three takes that I feel are the best that I can do with my singing abilities within a sensible time frame. Out of those three takes I compile the final track, this is called “Vocal Comping” (Owsinski, B. 2013). I don’t always need to combine takes to create the final track but often it helps to have those extra takes on hand if there’s something that jumps out at me in a negative way.

After this, if there is still something that needs fixing, such as timing or tuning, I take care of those needs with elastic time (a Pro Tools internal plugin) and Revoice Pro 3 respectively. When it comes to synching overdubs and harmonies, Revoice Pro 3 is a brilliant plugin. You just need to highlight the main vocal track, capture it into the plugin, do the same for the tracks that you want synched with it and with a couple of clicks you’re ready, all the tracks are synched up. This means that you don’t need to go through each overdub and harmony to make sure that for example all the “P”, “T” and “S” consonants are aligned. I’m not the most technically proficient singer, so often I’ll use the same plugin for a bit of autotune fine tuning. (Inglis, S. 2015.)

If you’re going for vocal tracks with a significant “analogue feel”, you can build your signal chain in the virtual mix rack to accomplish just that (Rogers, N 2016). The con-

figuration that I ended up going with most often, was to start with the VCC Virtual Channel set to “Brit N”, which models the characteristics of a Neve console, then the FG-M7 tube microphone, an FG-76 vintage mic pre, the FG-N Brit n EQ and finish with the FG-116 FET compressor (Rogers, N. 2016). Also in most tracks, before anything else, there is a virtual tape machine. Below in Figure 9 you can see a spectrum analysis AB comparison first with just the bare chorus vocal track from the song “Battlefield” and then with the virtual channel Neve model and FG-M7 microphone model switched on.

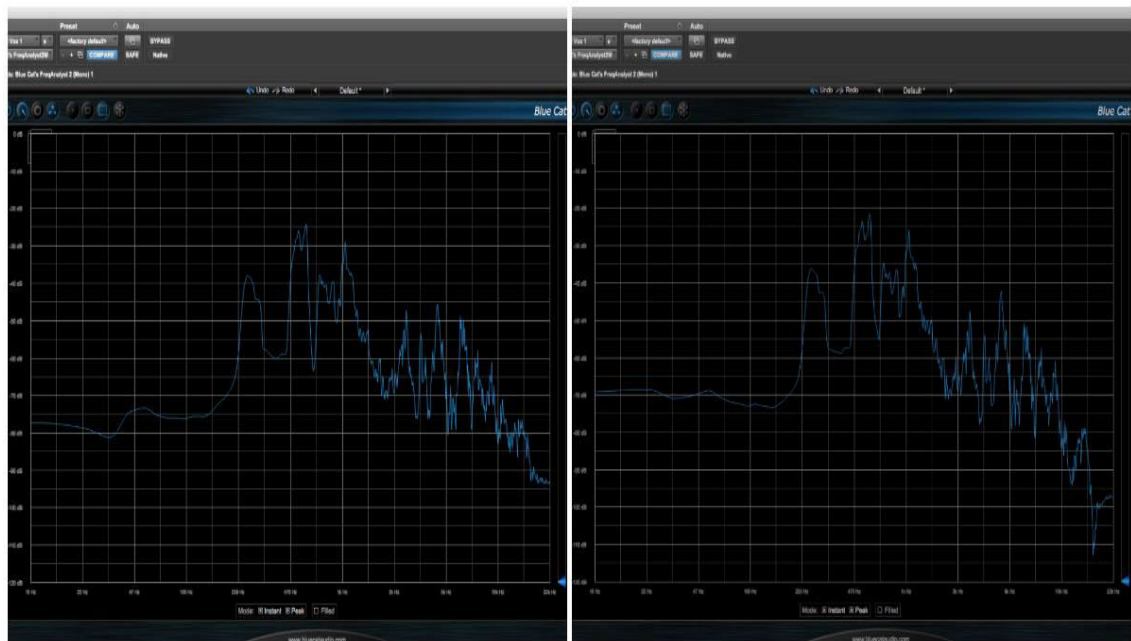


FIGURE 9: A spectrograph comparison between the naked vocal track (left) and modelled track (right) (Photo: Viljami Wenttola 2017)

### 5.2.4 Synths

The album contains some synthesizer tracks, mostly in the background as “pads” or as a tool to make the songs sound more epic, however in the song “The Call”, to really bring home the retro vibe I was going for, I added a Hammond organ solo. All the synths are played on an M-Audio Axiom 61 MIDI USB controller and get their sound either from the EZMix 2, Xpand!2 or Alchemy plugins. Although there are multitudes of better virtual synthesizers out there, such as Omnisphere or Massive (Nagle, P. 2015), synths aren’t really the focal point or primary instrument in these songs but rather exist to support the big picture, that is why I went with these “run-of-the-mill” plugins that I already owned.



## 5.2.5 A Word on Post-Production

Post-production is full of modelling technology. You literally can't open most Pro Tools sessions without running into at least a few modelling plugins, and unless you own your own hardware signal chain, you're going to be using modelling plugins to emulate some pre-existing tech with very high certainty (Kupiainen 2017). Although mixing is not a part of this thesis, I thought it pertinent to demonstrate, that with contemporary plugins, there is basically no technological need to own any of the famed gear such as tape machines (as seen below in Figure 10). At least not for sound reasons, however production and music is full of aesthetics when it comes to decision making (Hiilesmaa 2016). Whether it's because of the preference of using tangible hardware, using technology that you're used to, or just liking the principal of "the real thing", there will perhaps always be a place for professional studios that still carry the actual gear.



FIGURE 10: Slate Digital's virtual tape machine (Photo: Viljami Wenttola 2017)

## 6 DISCUSSION

The research for my thesis was not an easy task, as the subject matter is a continuously growing and changing one. It also became very clear to me, that there were very few specific publications about the topic, most Google searches will yield advertisements, many forums and opinionated articles. However, I was able to wade through the mountain of information and find reputable sources especially in the form of patent applications, interviews and articles from credible publications. Some academic texts were also very interesting.

I concluded that modelling is an every-day part of a music production professional's life, and that's a good thing. Even though a multitude of possibilities can distract and bring forth a swamp of choices, if you know what you're going for, the technology can be a good servant. Indeed, the mark of a good producer is to stay focused, to be aware of the tools at hand and use the one that gets the job done. After all, they're just tools.

I especially enjoyed interviewing four industry professionals and hearing their honest opinions about the subject matter. None of them had any principals on why use or why not use certain tools just because one is modelling and another is the real thing. It always depends on the project. To my intrigue, the experts did have some interesting points on how they would like to see the technology grow in the future, such as vocal modelling, a more personal haptic response or further research on guitar cabinet impulse modelling.

As a fledgling music production professional in my own right, using real, non-modelled equipment has always been a luxury from my point of view. I'm a poor student with limited possibilities so for one reason or another, using non-modelled real gear has always had an air of being better. Through my research however, I could dispel some of those mystical qualities and to remind myself that it isn't that much about the gear that you use, but what you do with it.

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## APPENDICES

Appendix 1. Facebook Call Interview Matias Kupiainen 8.3.2017

**Would you briefly tell us about yourself and your career?**

I am Kupiainen, I play guitar and I am a producer. I've been doing this as a job for about fifteen years now. You can call yourself a pro once you support yourself fully with what you're doing, right?

**How is modelling technology a part of your work?**

It's a part of each day. Let's say that ten years ago it wasn't quite a part of everyday working life yet, but nowadays it is. The softwares, impulses, IR and other technologies have gone through such huge advances in the last ten years. It's easier to go for the modelling, or modelled version rather than to go for the actual "real thing".

**Why do you think the technology has advanced so much within the last 10 years?**

Processing power has increased and people have put a lot of time and money into research to make the technology better.

**What kind of modelling technology do you use for example on the road with Stratovarius?**

Nowadays I do everything through the Fractal Audio Axe-Fx. In the Axe-Fx I have all my modellings and self-made impulses. From there it goes into my in-ear monitors and front of house. It's a very basic touring solution. Even though I have my cabs there on stage, they're not mic'ed. They're just there for feedback and show purposes, for rock'n roll. More is more.

**And the reason for this is because nowadays it's just much easier this way?**

It's easier and it means that it's the same sound day in, day out. And it's so much easier to get started when you have that same sound every day, instead of having to set up

mics for the rig every time. You can easily spend half an hour setting up mics because it's a game of millimetres to find that spot with the good sound, and it's slightly different every day because the venues change. For example, stage resonance should be taken into consideration, whether it's a low or a high space, are my stacks next to any walls, or in contrast it may be a big festival stage without any kind of resonance and you're practically outside. So even if you try and set the mics up the same way every time, they still won't sound the same. It saves a lot of time and it makes the technicians lives a lot easier.

**And on the production side, do you have any examples regarding modelling?**

Well yeah sure, when you're producing, mixing or similar, you're able to use much "heavier" tools because then it doesn't matter how much latency you get. For example, I use the "Torpedo" impulse plugin by "Two-Notes" a lot but it also generates a lot of latency. There's a lot of good modelling out there, I'm not going to start going through a list of names though. The problem is mainly that on the live side your signal chain must be relatively lag-free so you can play, but when you minimize latency you also compromise in terms of sound, so it's always "comme ci comme ça". For example, when you use some "heavier" impulses, it doesn't really matter what your sample rate is because the impulse should be able to "sniff out" the low frequencies correctly which again means time-wise one fourth of the wavelength, so the sample rate really doesn't matter. You could be using a very high sample rate and have a huge amount of CPU, but it doesn't matter because it's always that one fourth of the wavelength and that means the latency becomes so high that you can't play anymore, if you want to model what's happening in the 60 and 80 hertz frequency range that is.

**Are there some forms of modelling technology that you would rather not use? If so, why?**

I'm quite open with everything. If it works, it works. There's not really a thing that shouldn't be tried out at least, even if the sticker says "modelling". I think you should try all that stuff out and find the right place to use it.

**So you don't have any principals regarding that question?**

No, not really. About ten or fifteen years ago there were some because they sounded so horrible, but nowadays it's a whole different thing because, like I said, people have done so much research on the technology so I don't see any problem with it.

**You mentioned that ten years ago things were different, how has modelling technology changed your work during this time?**

Quite a bit, for example you can get a very good sound already during the demo phase and it makes things faster. Although sometimes it also slows processes down because it opens this whole new world and you can make up different types of sounds, you have this insane number of parameters to use, which is a big contrast to the older analogue gear where you didn't have many parameters to fiddle with.

**What about your profession in general and your colleagues? Do you think they have the same things to say? "Some good things, some bad things"?**

Yeah, good and bad. I am still waiting for it to go one more step ahead, but you must make do with what you have now. If we for example look at the life of a touring guitarist, modelling rules every part of it, and if you go to any festival you can see that no one is bringing extravagant amounts of amps or "war rigs" with them anymore because it can all fit into the space of two rack units nowadays. If you play in an international rock- or metal band, you must fly a lot to gigs, and these advancements mean that you can fit more in less space, less kilograms, less overweight fees, it all goes into a smaller package, but like I said, there's always a compromise somewhere. So, do you really want to take your huge, 250 kilograms weighing rig with you to some shithole in Spain when you could take your 20-kilogram rack that has everything ready in it but with a small compromise in sound. Money talks.

**Is there some change or advancement that you have not yet seen, but would like to see soon regarding modelling technology?**

There's one example of what bums me out in all of this, the impulse technology. If we could get that to go in some direction so that it wouldn't have to be an impulse anymore so to speak, but the machine could compute it in such a way that didn't result in such a big latency. That's what I'm waiting for most of all, because the preamps and power

amps are modelled very well already, they're like scarily close, but the problem is with these impulses. The impulses cannot model how the air flows between the microphone and the speaker and what happens within that synergy, what happens in the room at the same time. The bottom end is always the biggest problem, because it lacks the energy that comes from the air. It is lacking because the impulse that has been done does not take this into account. This is the reason that the impulse still doesn't quite sound realistic, no matter how well it is done.



## Appendix 2. Interview Jussi Kulomaa 10.3.2017

### **Would you briefly tell us about yourself and your career?**

My name is Jussi Kulomaa. At the moment, I am working at Tammer Piano ja Soitin Ky, the instrument store. I've also been running a studio and been mixing for over ten years. In 2002 I went to Orimattila to study for a degree in music technology. I've been playing in bands for over twenty years.

### **How is modelling technology a part of your work?**

As a keyboard player, I've noticed advancement in the world of synthesizers especially. If I remember correctly, the first virtual analogue synthesizer hit the market in 1995. It was a hardware modelling version of a pre-existing analogue synthesizer.

### **Do you remember the brand and model?**

It was the Clavia Nord Lead. Although my first was the Yamaha AN1x in 1997. If you compared those to analogue synths, they weren't quite "there yet" according to my experiences. In what comes to the sound and features... Let's just say it was a good start. Now-adays though, I've observed that most people have made the transition into plugins, and it's a completely different world out there these days. Pretty much the only people out there complaining anymore are the "anoraks" and the "neckbeards" on online forums, saying stuff like "this doesn't sound like my 1976 Roland SH-class synth", but so what?

### **Do you think that it's more of a question of attitudes or is this really the case?**

Both. I mean yes, I know that the digital modelling gear doesn't quite have the same kind of "hum", but you must remember that the originals are about thirty to forty years old, which means that the tolerances are come-what-may, the same goes for the quality of the components, so it couldn't even sound just the same. On these aforementioned forums people have made A-B comparisons between different production years and

conditions of the same particular synths and even though they're the same brand and model, they still sound different.

**And the same applies to microphones, modelling may only get you 90% close to the real thing, but even the old legendary microphones don't sound alike.**

Exactly, this is precisely the same question. And now we enter into the question of what is sensible, where do you draw the line? At what point does all of this become an obsession? Is the objective to authentically model something 100% correctly, or is it enough under the circumstances to get the job done well? "Is it aesthetically practical?" as Tipi Tuovinen so elegantly stated. Greetings to Tipi if he ever reads this or listens to this inter-view. Also, when it comes to post production and mixing, when we consider the budgets, we just don't have the time to tinker and play around with this stuff unfortunately. I mean if I had the money and time, of course I'd do everything with the original instruments, but unfortunately this isn't the case. So, in that case I open the plugin, click on the sound I want and onward. Especially after it's been mixed, mastered, packed, packed into an mp3 for iTunes, how many people really hear the difference? A better question yet, is how many listeners even care? Our mission here as producers and makers of music is to care about the quality, because if we don't care, the quality will suffer because otherwise we're always going by the lowest denominator. I don't really have any answers regarding this subject, except that I do my best with the tools that I have. If I had a budget of hundreds of thousands like in the old days, of course I'd do it like they did in the old days too, but you must work with what you've got.

**What kind of modelling technology do you use as a producer and as a musician? Also, as a follow up question, is there any modelling technology that you'd rather not use? If so, why?**

Recently I've been using Peavey's Revalver a lot, for guitar amp modelling. It saved one mix that I was working on, because the mic'ed tracks that I got were subpar in quality.

**So, they weren't line signal?**

At first just got the mic'ed tracks, but I asked them: "if you have the direct input line sig-nal tracks, please send them to me". Luckily, they did. That's how I got it to work out in the end. It wasn't 100% there, I don't know if it was just a question of working with a new plugin or a question of tweaking it a little more. There was a lot of room for tweak-ing, even more than I personally would've wanted, but what I personally liked a lot that you can still tweak and change settings even when the mix is in later stages, so I don't have to even go to the EQ, I can go straight to the source. The less I have to touch the EQ or other plugins, the better. Also, it's nice, when it comes to amp modelling, that you can change the placement of the microphone. That was handy and I liked it immensely.

### **You can probably change what microphones are used as well?**

Yes. Although, if you wanted to use a specific microphone, you of course need to buy it. Ok, they're not very expensive, I get the business idea, I like it. One danger in those things is always that you start tweaking too much, you don't see the forest from the trees, and that's not a good thing. You have to remember that these are just tools. You can play with them on your own time, but especially if it's a project or a job, it has to be quick. A paying customer does not want to hear that the mixing engineer wants a little bit more time to fiddle around with settings because he/she doesn't care.

On the synth side, I do use a fair amount of modelling technology, but for example when it comes to the software side of things, I don't really use those plugins that emulate old analogue synths. I value that "hands on" experience a lot, that you have those potentiometers and actual keys. I do use software synths too, but mostly the kind that don't model any specific pre-existing sounds. I have used the mini moog and rocket five emulators too and they can sound great and no problem, don't get me wrong. A good example would be the Yamaha CS80, I used to own it and afterwards I tried the plugin versions too. I mean yeah, the sound is there in a way, but that synth is a good example of a synth where the sound isn't really "the point" so to speak. The point is more to do with what you can do with the actual keys and controls in real time, and that's something that you can't emulate with a plugin interface. Yeah, sure, you have all these MIDI keyboards that have all kinds of potentiometers and sliders, but in this case, it isn't the same thing. It's kind of the same thing as if you had a modelling guitar software versus an actual guitar. Guitarists understand right away what I'm talking about at

this point. On the keyboard and synthesizer side, most people are not really players, but rather tweekers. Turn the knob and see the MIDI go.

I can't really say if there's anything that I wouldn't use. It's more of a question of if I find that something doesn't sound good then I just don't use it, I don't automatically say no to anything. For example, I have Waves plugins that model SSL desks, or Universal Audio 1176 compressors. I'd like to use the real things but I don't have the money or room for them.

### **Has modelling technology changed your job somehow? If so, how?**

It's made everything faster. Especially with plugin functions and features like "recall" and memory patches. When it comes to for example guitar amp modelling, I don't know that much about it because I've only recently started looking into the matter because they're only now starting to sound like how I think they should sound.

### **Why do you think this is? Why are they starting to sound good now?**

There hasn't been enough processing power until now. People haven't investigated what's happening inside the amps in the right way until now. They started out researching it all from the wrong angle: by trying to sound like what's coming out of the speaker instead of what's happening inside on a component level. Only now with modern processing power and computing memory we can start to go into the component side of things, to analyse what's going on in there. Because the sound is produced by these components being in a certain way, that's what determines what's coming out of the speaker. The Line 6's and Roland's Cube models back in the day looked at the matter and modelled the whole chain from beginning to end, what it sounds like when it's coming out of the speaker. Therefore, to my ears, it's always sounded like I'm listening to a sound that's already been recorded once. That's not a good thing in my opinion, I want to hear the actual real thing, and only then I want to put a microphone in front of it. Now they're starting to sound like what they're supposed to sound like. You don't even need to reamp anymore, although the beauty here is that these things aren't exclusive. If you see that one technique works for something better, then go for it!

**And generally, in your field? Have you seen changes among your colleagues and your co-workers?**

Yes, slowly but surely the old head-cab configurations are starting to get replaced by rack solutions or footswitch/pedal type solutions, with guitars especially. A lot of keyboard players now have a laptop and a MIDI keyboard, that's it. So, people aren't carrying big rigs with them anymore. Also, here in the instrument shop, clearly smaller gear is more popular now. The less to load, the happier everyone is. Here on the retail side we can see that modelling is starting to get so good that even the most devout "tube purists" are starting to get interested and try out this new gear.

**Is there some change or advancement that you have not yet seen, but would like to see soon regarding modelling technology?**

That's a difficult question. It feels like that something would have to be so revolutionary and out of this world that isn't grounded or rooted in any of these "traditional" instruments.

**What about if we think of existing technology, how could that be improved upon?**

One thing that could slightly be improved upon on the guitar modelling side is that so-called "mojo", I think that's still lacking a bit. That slight breath that you get with tube amplifiers.

**Are we talking about for example the low end or...?**

No, it's not really any one thing. Maybe it's a placebo thing, but that feeling you get when you put on a tube amplifier, it's living and it's reacting. Those chaotic non-linear things. I think that's something that people will look into next. Because with modelling guitar amplifiers, when you turn it on you get exactly what you want. That kind of chaos element and non-linearity is what I'm still missing. I'm not talking about that it sounds like a Fender one day and a Marshall another day, but that it's got that "something".

One important thing is that us humans, we have hands and we like tactile things. It's a completely different thing to sit behind a laptop with a MIDI keyboard than sitting be-

hind a real synth. So, I'd like to see an improvement in this field. A keyboard that has the same feel as the old real thing but has all the new improvements like memory storage and re-calling features etc.

### Appendix 3. Email Interview Hiili Hiilesmaa 14.3.2017

#### **Please tell us briefly about yourself and your career in music.**

I had a C-Cassette recorder, drums and an electric guitar at home when I was in primary school. After classes, we'd go to my place and record some rock'n roll. When my friends went home, I would stay and analyse the material and how it could be played better, the next day during recess I would give the guys my notes and we would go record the new versions. So, my introduction to recording was through playing around, we hadn't even heard of the term "producer", let alone seen a picture of a studio at that point.

These days I run my own music production company and I have clients in over ten countries. I have also recently founded a record company with a brand-new concept with two business partners. I have a Bachelor's Degree in music production and a specialist degree in business leadership. I also frequently teach music production students at Tampere University of Applied Sciences.

#### **How is modelling technology a part of your work?**

It's a daily part both in mixing and recording. It is always present.

#### **What kind of modelling technology do you use and why?**

In guitar sounds, synthesizer sounds, drum sounds, reverbs, etc.

The reasons for these are multiple. You can for example change the sound drastically at the blink of an eye compared to building a different set up each time.

You can go through different alternatives in a short period of time, this saves money, money that can be used on other important costs. This is one of the core objectives of being a music producer.

It's more enjoyable to use original gear if the songs have few tracks, this is because the original gear may deliver more randomness. The original gear can at times hum and "brum" in a completely unique and non-modellable way.

The pros of modelling are manifold also in the demoing process, you can record your ide-as quickly with good sounds. Although, you can record onto C-Cassette just as quickly if you run out of cell phone battery for example.

**Is there any modelling technology that you'd rather not use? If so, why?**

A natural sound feels more genuine, even if you can't always tell with just your ears. It's fairly commonplace to agree to not use any modelling technology for the sake of "feel". The most enjoyable thing is to create completely original sounds if you have time, alt-hough I'm not saying that you can't do that with modelling gear.

**Has modelling technology changed your job somehow? If so, how?**

It's very handy that nowadays you can for example reamp guitars even if the bulk of the recording is done for free at home with a relaxed schedule, although the fact that we can outsource and put off so many things nowadays makes for more hassle compared to the past.

The haste that modelling technology affords can also make even the smallest budgets adequate. Especially if you're satisfied with "ok" quality in a small time frame.

My job hasn't changed much, but I do know some people that offer services like guitar modelling over the internet.

**And generally, in your field? Have you seen changes among your colleagues and your co-workers?**

It's kind of simplified, really, for example in metal music the sounds that people use are very standardised. Many mixing engineers just use pre-sets while mixing drums. This is also because a lot of bands want to sound like their idols and influences. The same phenomenon is also very true in the EDM genre.

Back in the old days, in the studio guitarists used to have unique gear that no one else owned and productions would sound more unique by default because of this. However, if we had the same modelling technology back then, I'm sure we would've used it too if it were possible.

We need more courage and risk taking if we want to achieve greatness.



**According to your personal experience, how has modelling advanced during the last 10 years or so?**

Modelling technology has gone forward, but creative and original ways of making music haven't really. 10 years ago, we used Line6 amplifiers a lot, they were not very good at modelling comparing to modern equipment. Equipment from that era also operated with a slight latency, and that made serious use impossible.

The first Leslie-Amplifier modelling solutions arrived sometime in the 90's and it was a great relief realising that we didn't need a rental van anymore to transport a heavy Leslie-amplifier to a small studio.

The whole practice of digital recording is "modelling". For reasons such as "feel" we still have productions that don't use that technology. Modelling is an every-day, and natural part of productions. It makes many things possible that in the old days we couldn't make happen.

**Is there some change or advancement that you have not yet seen, but would like to see soon regarding modelling technology?**

For 10 years, I've been waiting to see technology that changes my voice into Elvis' voice. Then I wouldn't need to deal with singers anymore if I didn't absolutely want or need to.

#### Appendix 4. Email Interview Jem Godfrey 30.3.2017

##### **Please tell us briefly about your career in music.**

I started out working in radio after an attempt at a music career failed. Later I re-entered the music world via some contacts I'd made while working in radio. We ended up having a fair amount of success making pop records for 5 years. After that I co-founded 3 music companies specialising in jingles, library music and radio production audio respectively.

##### **How is modelling technology a part of your work? (software and/or hardware)**

It's an enabler for me to experiment with sound. To be honest though, I don't really think about it when I'm using these bits of hardware or software. I don't really notice them most of the time, which is probably a ringing endorsement of their design actually.

##### **What kind of modelling technology do you use and why?**

I use AudioEase's Altiverb a lot for the unusual (and mainly small) spaces you get with it. I also use a Kemper Profiling amp for my guitar sounds. I also have a Roland System 8 which I guess is an analogue modelling synth. I've always meant to have a play with the Pianoteq stuff too, but it still sounds a bit computer generated to me.

##### **Is there any modelling technology that you'd rather not use? If so, why?**

Not really.

##### **Has modelling technology changed your job somehow? If so, how?**

It's enabled me to climb inside a vacuum cleaner tube and sing. It's also enabled me to sing through a through a PA at Wembley Stadium as well as in the back of a Ford Transit van. It's also let me play through a bunch of amps I'll never own and play the synth sounds of long since discontinued machines.

##### **And generally, in your field? Have you seen changes among your colleagues and your co-workers?**

A lot of people I work with bought Kempers recently. Including me.

##### **According to your personal experience, how has modelling advanced during the last 10 years or so? Do you have any insight as to why these advancements have occurred?**

The main advances have been in processing power, therefore latency, therefore feel and therefore performance. I remember back to the days of Line 6's Amp Farm plug-in for ProTools and how wowed I was by the idea of having 6 or so amps in software, good to go. Simpler times... They didn't even sound particularly good!

##### **Is there some change or advancement that you have not yet seen, but would like to see soon regarding modelling technology?**

Vocal modelling would be interesting. You sing one thing and the computer turns you into Tom Jones or whomever you prefer!

Appendix 5. Thesis project album.