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Computer Technology In Modern Music:

A Study of Current Tools and How Musicians Use Them

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Abstract

This paper presents a range of information about technology in music and examines how computer-based musicians are implementing this technology. The first part considers how the compositional framework of author, audience, and purpose applies to these musicians. The second part examines the crucial hardware and software tools that combine in these systems to work as a singular rig and instrument. The paper also covers some musical aspects of computer-based music projects, including mixing. The final element discusses advancements of virtual tools, and how they are surpassing the capabilities of hardware gear. Much of the research presented comes first hand from successful musicians who use computers as central components of their workflows, and is based, in part, on an internet survey conducted by the author.
Computer Technology in Modern Music: A Study of Current Tools and How Musicians Use Them

Technological advancements are having a profound effect on how modern music is being created and performed. In recent years, the so-called “computer revolution” has spurred new, powerful capabilities for musicians. Computer-based musicians are in many cases using their personal computer as the central component for the composition, performance, recording, mixing, mastering and performance of their music. Trends indicate that this computer technology will continue to grow in popularity amongst musicians, both professionals and hobbyists. This research project is a study of modern computer based musicians, focusing on compositional elements. The author will begin by introducing the widespread concepts of author, audience, and purpose, and will then describe how understanding the theory is especially relevant in this context. From there the paper will dive into the tools popularly used and sometimes required for computer-based composition, and how they work together. Then, it will briefly address some musical elements of computer-based music projects, which includes mixing. Lastly, findings are revealed about major advancements with software components of computer music systems. Computers have a significant impact on modern music; this analytical paper breaks down various aspects of what goes into using computers to create music and showcases some of their capabilities.

Author, Audience, Purpose

When a the composer reflects upon whom they are as a musician, who the intended audience is, and the reaction the musician intends the audience to have when
they consume the music can make a creation most effective. When thought of in terms as author, audience and purpose, the musical journey begins with a valuable mindset. These concepts are applicable to all musicians, but especially important for computer-based musicians because of their the ability to singularly program sounds of virtually any instrument or soundscape. Knowing how to channel and embody a fitting style or sound is crucial.

A first objective is to begin an analysis to understand who the creator is as an artist, (author). In this musical context, the focus will be on cultural upbringing (with an emphasis on the musical aspect of culture) and musical background. In an article published by the Northwestern University Press entitled, “The Anthropology of Music,” ethnomusicologist Alan P. Merriam depicts the relationship between cultural upbringing and how the upbringing works with musicians specifically stating,

“It is through education, enculturation, cultural learning, that culture gains its stability and is perpetuated, but it is through the same process of cultural learning that change takes place and culture derives its dynamic quality. What is true for culture as a whole is also true for music; the learning process in music is at the core of our understanding of the sounds men produce” (Merriam, 1964).

Here Merriam suggests that music had listened to by musicians in their past (perhaps grow up listening to) and the music they choose to listen to on a daily basis will influence music that they create and contribute to their cultural identities. Giving thought to and reflecting upon our lifelong collections of taste, acquired by intellectual and
aesthetic training (seemingly conscious and subconscious), can be a great starting point for computer music composition.

Prior musical training is another vital element to the music creator's identity and will sculpt the quality and flavor of a musician's computer-based composition. Though having experience playing an instrument is not required to create successful computer based music, there is no doubt that having a great understandings of advanced musical elements is valuable. In “The Digital Musician.” Andrew Hugill breaks musical backgrounds up into three types: pitch orientation, rhythmic orientation and timbre orientation.

The first background Hugill identifies is pitch orientation. Types of instruments in this category would be example instrument groups like strings, brass, woodwind, and voice. Here, notes can create expressive melodies and blend to create lush, colorful harmonies. Hugill makes a connection between pitch orientation and classical training or certain genres when stating,

“Many musicians who knowingly work within highly established traditions, such as ‘classical’ music and certain forms of ‘folk’ music take pitch as a starting point for their musical training. These musicians generally play an acoustic instrument as their main practice, and they travel a prescribed career path that involves the gradual evolution of technique and musicianship” (Hugill, 2012).

This identifies one type of musical background that would have a great effect on someone’s musical identity. For example, if someone were to have played trumpet in an orchestra before starting to compose music on a computer, they may have an inherent
tendency to program a lead melody before a drum rhythm or even a chord progression. One significant genre that Hugill did not include in this excerpt is jazz music, which often develops an instrumentalist's ability to improvise and solo.

Another type of musician who possesses a different musical understanding is a rhythmically oriented musician. Rhythm is the focus of many genres around the world, especially those often accompanied by dance. Hugill relates rhythmically oriented musicians to pitch oriented musicians with the claim,

“Another type of musician may begin with rhythm, or at least beat. This includes rock and most forms of popular music. Musicians working within this tradition tend to show a relative lack of interest in pitch when compared to the first type, although of course they do not ignore it completely” (Hugill, 2012).

Recognizing that rhythm is a vital component of most popular music has merit. A lot of computer-based music, in particular, tends to have a strong emphasis on rhythmic elements. These rhythmically oriented musicians often have a better sense of how to make the different parts of their music better groove together. This all suggests that musicians of this orientation would be best suited to focus on how their parts align rhythmically.

The third type of orientation that Hugill identifies is less obvious, a timbre oriented musician. Timbre is commonly referred to as tone, which is comprised of a sound's spectrum and envelope. These factors determine qualities like the sonic color, and they make sounds distinguishable between different instruments. Musicians who are able to create pleasing timbres stand at an advantage. It certainly doesn't mean that pitch
or rhythmic orientated musicians cannot create fantastic timbres, but rather it is true that some people have inherent abilities to sculpt amazing sounds, even without extraordinary performance skills. Hugill identifies these musicians and makes a claim,

“A third tradition starts from timbre. This type of musician is harder to pin down, for the simple reason that timbre-focused artists do not consider themselves to be musicians at all, or do not use the word ‘music’ to describe what they produce.”

He goes on to say, “By dealing with sounds rather than notes, these musicians have changed the nature of music itself, raising questions about what is ‘musical’” (Hugill, 2012).

It is important to realize the significance of being able to create pleasing and interesting sounds. Sculpting tones that stimulate a listener’s attention is extremely musical in and of itself. Computer-music composition has such vast possibilities with sound creation and processing. Some musicians are simply great at forming sounds people enjoy hearing and that is the value of their musical background.

In summary, the first component of computer music composition is analysis of the composers themselves. Their cultural identity and their musical backgrounds will both have profound effects on the music they create. There is much to be gained from reflecting upon a composer’s unique qualities. Merriam's article and Hugill's framework suggest that by applying these traits, their music will be at an advantage.

Gathering a foundation of who the composer is as a musician is a starting point. The next aspect of consideration for this model is addressing to whom the musician is trying to appeal. Broadly stated, understanding an audience's tastes and expectations will
make a composer’s efforts easier. In an instructional article hosted by the University of Maryland, writing strategies are presented to students. Though the context is rhetorical appeal for essay writing, the themes are equally applicable to music writing. The claim is,

“No matter what the writing project, you should plan to write to someone—that is, you should target an audience for your writing assignment. Audience analysis is crucial to understanding what should go into each piece of writing. You should consider your audience’s needs.” They go onto say, “Analyzing your audience will help you make the necessary decisions about what you will write” (University of Maryland).

In the context of music, these topics to analyze are the audience's interest in aspects like characterizing timbres, feel of rhythms, types of arrangements, and tempos. In many cases, people create music to be consumed by an audience with similar cultural identities. Being submersed in a particular cultural scene connects people who create the music with people who consume it, and the relationship comes naturally. In other cases, musicians are hired to compose for someone else's project, for instance a movie soundtrack, a television commercial or an art installation. These cases have expectations that may be different. To satisfy the specific audience's expectations, the writing principles suggest that gauging stylistic adjustments that must be made and having versatility seem beneficial for a successful product. The composer may simply compose for him (or her) self. A successful product would fulfill the song's subjective purpose.
There are infinite possible 'purposes' for music that is created. Some are to satisfy commercial interests, like record sales or approval by a paying client. Others regard more personally rooted appeasement. The author conducted an internet survey to ask computer-based musicians questions about their work. Eight questions were hosted by an internet website where participants could submit their replies anonymously. In total there were 91 entries. One question of the survey was, “What do you want your listeners' response to be when they hear your music?” The answers to this question had some similar themes. The most common simple short answer was “dance.” Other prevalent responses had to do with impressing listeners. The four responses below illustrate the range of responses.

Response example #1 brings up emotional impact stating, “Enjoyment, interest and primarily a sense of emotion. Like all forms of art, music can stir emotions, memories and senses. If I can accomplish this, I have met my goal.”

Response example #2 addresses audience or contextual awareness stating, “It depends on the project. For my musical compositions, I often want them to think my music was clever. When I do sound effects for theatre, I want them blend in with the play.”

Response example #3 was more focused on strength rather than type of impact stating, “I'm more interested in the intensity of their response than in the actual response itself. The more intense the response, whether positive or negative, the more the music got to their soul.”
Then there was the fiscally conscious example #4 stating, “I want them to be so impressed that they purchase my all my music and merchandise and share with all their friends.”

The compositional framework suggests that the compositional process of computer-based music begins with introspective analysis of the creator. The author's cultural identity and the author's musical background both have significant effects on the content that they create. The second part is acknowledging who the audience (or intended audience) is, and their expectations needed to be met. The third part is the purpose of the music; what is the intended response from the listener? With all of these considerations in mind, the created music stands a better chance of being effective. This approach applies to computer-based composers in particular, because modern tools create vast sonic possibilities. Once the vision is created, realizing musical ideas is the next step.

**Compositional Rig**

With solid ideas to embark on a project, musicians go about acquiring the appropriate equipment to satisfy creative needs. In this part of the paper I will identify modern computer-based music composition systems, and explain the inter-workings of the components. There are many elements of these systems to make them work efficiently and some components are more inherently
musical than others. Together, the whole unit in its entirety is used to compose and create music as an instrument. This instrument is at the center of this modern music rig is a piece of everyday technology that many do not identify to be an instrument at all: a computer. Initially, music recording had been done completely in an analog domain. Computers first presented a way to digitize recordings by printing sounds to a digital drive, rather than using a tape machine. Digital recording offered significant advantages, but at the beginning there were many drawbacks regarding speed, track count restrictions, and sonic characteristics. As computers become exponentially more powerful, these downfalls continue to be less and less noticeable. Now most recording studios primarily use computer systems, and many computer musicians have become self-reliant.

Within a computer system, certain components are vital for creating appealing music. The most impactful unit of the computer, one that will dictate many musical capabilities, is the processor. The most important chip in a computer is the central processing unit, known as the CPU. Modern CPUs contain millions of transistors the size of an average thumb's width. These highly complex chips will determine important aspects of a computer music project such as, possible track count, amount of virtual instruments, and number of sound processors on channels. The second most vital component of the computer system for a music project is the hard drive. A hard drive is a high-capacity, self-contained storage device containing a read-write mechanism. The speed at which this disk can read and write the information will affect similar performance issues as the processor. Hard drives store components of the project like recorded audio, sample libraries for virtual instruments, and algorithms virtual processors. A well-functioning, high-speed hard drive presents greater possibilities for
projects. These two computer components (CPU and hard drive) dictate how much information a computer-music project can handle.

Inside the computer, all data is stored as binary code. Ways of interacting with this data have changed over the years to become more intuitive. Right now, the mouse and keyboard are the two major ways most people input information, and a monitoring screen is used to view what is going on. Having a precise mouse and a large screen would make this interaction more effective than a clumsy mouse and tiny screen.

While visual monitoring can be helpful with music projects, being able to hear the sounds you are working with is vital. Speakers connect to computers, and through a process known as digital-to-analog conversion, binary code gets changed to analog audio. The process works in reverse as well. A glossary published by the popular music technology website *Sound on Sound* provides a detailed technical definition of this process. They define an analog-to-digital (A/D) converter as a, “circuit for converting analogue waveforms into a series of equally spaced numerical values represented by binary numbers” (*Sound on Sound*). Most computers have A/D converters built into them, but the quality of this conversion is variable. Many computer-based musicians invest in dedicated interface units to optimize the conversion quality and expand the number of input and output channels. Plugged into the converter can be loudspeakers or

![Image of a professional industry standard converter](AVID, HD I/O)
headphones. With this accomplished, musicians can make decisions from accurate information when sculpting tones and mixing tracks; the sonic characteristic of headphones and loudspeakers will inform adjustments. Now with the understanding of information input and output of a computer and insight on how to make this basic principle musical, let’s go into detail about tools used to do this.

MIDI controllers present many musical data entree possibilities for computer-based systems. They are being made in many varieties; the most popular form is in replication of a piano keyboard with white natural notes and black sharp/flat notes. When a key is pressed, information is gathered that can be read by a virtual instrument as pitch, duration, and velocity. Midi keyboards are being made with three varieties of feel for the keys. There are weight hammer keys, which have a response most like a pianos keys; semi-weighted, which have less key resistance and a springier feel; and finally synth action, where the keys are light and return to resting position quickly for fast playing. With these devices, a musician can have hands on experience interfacing with a piano keyboard, while utilizing the benefits that computer technology offers. Keyboard controllers can adapt to input information effectively for a wide variety of virtual instruments, and controlling these instruments through a keyboard interface can help make them sound and feel musical. Connected to a computer, they control virtual instruments that can realistically sound like a drum set in a large church, a saxophone in an intimate jazz club or a synthesizer from outer space. The keyboard controller is the most widely used of all controllers, and it is thought of as the most versatile. However, other controllers can present a more realistic feel for controlling virtual versions of non-keyboard instruments.
Midi controllers are becoming very popular tools integrated into computer-based systems, and they come in many varieties. In addition to midi keyboard controllers, other prominent controllers are drum pads, wind controllers, midi converters on guitars and bass guitars, drum sets, rotary effects knobs, sliding faders and more. All of these convert musical actions to computer information. These controllers are similar to keyboard controllers in regards to note value, duration and velocity; the only difference with these alternative controllers is feel, which can have a significant impact on playability and articulation. Playability and articulation will influence the performance and create more realistic musical data input and provide comfort for musicians playing the controllers with various skill sets. Drum pads create the feel of a drum machine and trigger samples or a sound generator in the computer. Midi drum sets are arrangements of pads that feel like drums, which when struck, trigger the same kind of information for an electronic drum brain or a computers sound generator. With dynamics having so much to do with groove, these controllers can save drummers a lot of time getting their virtual drums sounding incredibly realistic. Rotary knobs and sliding faders can present hands-on control of virtual parameters. These motions can make adjustments more

Figure 3: Midi controller with drum pads, semi-weighted piano keys, faders and rotary knobs (AKAI, MPK 49)
musical than a mouse. The commonality of all of these modern music devices is that they are essentially useless without being connected to computers and music software. In relation to the entire computer music system, these controllers are made for people to play music, which will output computer data rather than sounds until virtual instruments are introduced.

With computer-based systems, virtual instruments are not the only ways to get sounds into projects. In fact, many computer musicians try to incorporate analog sounds regularly to add a natural and realistic element to their music. The two ways of incorporating analog sounds in a project are feeding microphones or direct injection signals into the A/D converter. Computer musicians often talk about what real instruments are in their music, and how they incorporated them.

Electronic and hip-hop music producer Denis Jasarevic, who goes by the alias Gramatik, is known for his urban sound, mixing old samples and crisp programmed drums grooves. He provides insight to how he feeds analog sounds into his computer and works them into his projects stating,

“I play keys and the bass lines and electric piano and then I have a couple friends that are really good pianists, and FAQ plays guitar with me on stage. We

Figure 4: Large Gramatik concert with Denis controlling Ableton via a midi controller and electric guitar performance through the software amplifier and effects emulations of Guitar Rig. (Thissongissick, Gramatik Live Concert)
experiment a lot, sometimes I'd pick up the bass guitar and chop that up. I do everything in Ableton” (Lost in Sound).

In a more extreme case, electronic musician and DJ known as Gaudi talks about doing as much as he can with a project before the music enters the digital realm. He reveals,

“I'm working with live musicians and creating sounds in almost every other way imaginable other than by computer. Although the tracks are arranged on computer, there's a lengthy process of recording sounds and manipulating them (old school analogue style), before they even get near a small grey box!” (Better Propaganda).

Although both of these musicians depict a lot going on outside of a computer (especially Gaudi), everything in their work ends up being processed into binary code to be worked on as a computer music project.

Microphones have been primary tools used to record music since the early 1900's, and today are still very widely used, even in computer-based pieces. Microphones are used to capture a wide range of sounds like acoustic instruments (including the human voice,) amplified instruments, and sounds that

Do you record and incorporate Analog Instruments into your music? (This would include any sounds captured with a Microphone, or electric instruments fed into an A/D converter through Direct Injection)

Figure 5: Survey results about analog instruments used by computer-based musicians
may not be very conventionally musical. Many artists use them to add more timbral variety and depth to their music. An important aspect of consideration with a microphone is the space and air in between the source and the face of the microphone. Complex variables such as the ambient noise levels and acoustic properties of the recording space impact the recorded sound. A typical example of a microphone in a computer-based music project could be a vocalist singing a short hook over the breakdown section of an electronic-house song. An example less typical may be a computer musician with a background in world percussion who adds layers of instruments like congas or tablas to their synthesizer-heavy songs. People use microphones for ambient recording and various found sounds in their projects as well. In an interview with popular music magazine *Electronic Musician* internationally recognized DJ and producer Deadmau5 talks about how he infuses his hit club songs with natural soundscapes captured by microphones stating,

“What I do a lot, I take two SM57s, go up on my roof and just hit record. I've got about a 20-minute long file of this that I've been using forever. You bring it down to -18dB, to where I can just start to hear it” (Levine, 2011).

With the perfection of computer technology and the interesting inconsistencies of the natural world, microphones fed into a computer create such vast possibility.

Similar to microphones, direct injection is another way that real world sounds are brought into computer music projects. Direct injection or DI is an analog sound source that is captured with some kind of pickup and fed electronically through a wire. *Sound on Sound*'s glossary defines it simply “where a signal is plugged directly into an audio chain
without the aid of a microphone.” Example of instruments that are directly injected into computer systems are electric guitars and basses, analog synthesizers, acoustic electric instruments (using piezo pickups) analog drum machines, and turntables. Although there are many virtual emulators of instruments like bass guitars that can be played with midi controllers, many musicians believe that real instruments to have a richer natural character, which will better suit their project. A popular trend is to blend acoustic instruments with computer processing applications. German company Native Instruments is one of the current leaders in computer synthesis and analog modeling software. Their hit product called Guitar Rig is designed for (but not limited to) a signal plugged DI into a computer, where the user can select emulated amplifiers, speaker cabinets, microphones, and effects with an amazing amount of realism. The processing power of what software can do to enhance audio has made direct injection very popular for many instrumentalists using computers. In a more unconventional use of direct injection, Canadian electronic Musician and Dj Akufen uses music concrete principles of found sounds with drum programming. In an artist interview with the music software developer Ableton, Akufen states,
“The new material I've been doing lately has way less 808 or 909 percussion. Most of my new kick drums are found sounds often made out of different layered radio noises and the Drumsynth 2.0 software. Same process for my hats and snares.” He goes on to say, “I take sounds from everywhere now. The radio became more of a trademark time after time. Now I'm using the television, the telephone and some field recordings almost as much, but there is something with the radio that fascinates me more. It's this organic flow” (Herrmann, 2012).

Again, the possibilities of what can be fed into computer music software are virtually endless. Direct injection is a popular way to feed virtual processors and get sounds integrated into computer music projects.

The central software applications for computer music sessions are called DAWs, which stands for Digital Audio Workstations. While serving many functions, their main role is to record audio and/or MIDI, provide windows for arrangement and mixing, as well as to host plug-ins (which will later be covered in detail.) Most DAWs have apparent relationships to analog recording system with their layouts and functionality, exemplified with features like transport control. In arrangement views, audio and MIDI tracks are stacked vertically, and are displayed on a linear timeline. A convenient feature that many DAW arrangement windows have is a grid that corresponds with rhythmic values of a project's tempo. Mix windows often look very similar to analog mixing consoles. Each channel can host a mono or stereo track and have insert points, panning knobs, auxiliary sends (pre or post fader) and volume faders. Modern systems are incredibly flexible with track counts, routing possibilities and processing power.
Launching the DAW application is in most cases the initiation of the computer music session.

**Musical Elements**

When approaching a new session, computer musicians have various ways to get started. Some have saved templates and preselected sounds to work with, while others start a project completely fresh and scrutinize creating each sound specifically for the individual song. Both strategies have advantages and disadvantages. Pre-selections can help with speed and enhanced continuity, but sound individuality between projects may make for interest and timbral diversity. Successful electronic music producer Lorin Ashton who makes music under the alias Bassnectar, is an advocate of pre-organized session templates and provides insight to his workflow stating in an interview,

“I really advocate simplicity. Pick your five kicks, pick your five snares, pick whatever your sub-bass signal is gonna be. Pick a couple of atonal dives. Create them in Massive or pull them out of a sample kit, put ’em in a drum rack, save that drum rack. Save a channel strip. Pick one synth. Then just try to make a couple songs, whether it’s Massive, [Tone 2’s] Gladiator, [Rob Papen’s] SubBoomBass, or Albino, just pick one sampler. Pick just one folder of samples. Then box yourself in with one sequencer and just work for a while” (Ware, 2012).

Ashton implies an ideology here that people get distracted with always creating different sounds with synthesizers, drum samplers and the many other possible components of computer music projects; all of these concerns can take focus away from the compositional process and digging deeply into the music itself. Ashton suggests that
the technical aspects of timbre creation can easily divert too much attention away from the musical aspects of composing melodies, harmonies and rhythms. In contrast, some computer-based musicians feel like timbre creation and finding specific sounds that fit especially well into particular songs is worth the time and attention. In a Sound on Sound article, the team who worked to make Kanye West's number 1 UK and US hit “Stronger” in 2007 reveal the extensive technical processes of creating the song. In sharp contrast to Bassnectar's approach, this group emphasizes the amount of detail that went into each small aspect of this specific song's sounds. One particular excerpt showcases the amount of detail in the process:

“The beat was extremely hard to get. Getting the kicks right was probably the biggest challenge in mixing this song. I think we ended up auditioning a dozen different kick sounds in different combinations, with different EQ, plug-ins, outboard, different filters and triggers, and so on” (Tingen, 2007).

While each kick sound this group auditioned, likely had fantastic timbral characteristics (especially with the described processing of these kicks), the fact that they did not stop short in finding the one they were most happy with speaks to the emphasis of catering to each specific song's individual needs. Choosing to have an advanced starting
point or beginning from the ground and working upwards are two very different ways to getting a project going and both have their advantages and shortcomings.

The music can then develop in a number of ways. Some computer musicians program drums before anything else. Others fly in samples to spur creativity. Perhaps the musician will realize a melody in their head. The possibilities are endless. A bass line can follow a drumbeat; a chord progression can accompany a melody. The major commonality for most successful computer music is an advanced understanding of compositional principles. Arrangement to make a song progress in an interesting way, harmonic structure to make pleasing sounding chord movements, rhythmic structures to lock in tight grooves and other insights of effective composition are important in this context. Many computer musicians believe that music theory training proves to be beneficial. In an instructional text entitled *Music Theory for Computer Musicians* author Michael Hewitt claims,

“Beneath all the enormously different styles of modern electronic music lie certain fundamentals of the musical language that are exactly the same no matter what kind of music you write. It is very important to acquire an understanding of these fundamentals if you are to develop as a musician and music producer” (Hewitt, 2008).

Music theory is an expansive topic that is a focus of all types of musicians' study. Hewitt suggests that computer music significantly benefits from developed music composition understanding and theory principles.
A component for most computer music projects is a mixing process done by the musician, not a separate engineer. By doing this, many computer musicians consider themselves to be producers, taking on composition, performance, arrangement and engineering duties. Aspects of mixing include technical processes like applying fitting amounts of compression and using equalizers to carve out space for everything to fit nicely together, as well as creative elements like creating virtual spaces for the mix and adding effects to make sounds more interesting. The mixing process can also interact with the compositional process. Programming changes in processor parameters, called automation, is a common way of heightening the interest of music and making the songs progress smoothly through timbral variation. For instance a widely used tactic is to automate the frequency of a filter to make sounds enter or exit a part of a song gracefully, build and release tension, or achieve many other possibilities where timbral change is a focus of the piece. In the survey conducted by the author questioning computer musicians, the results were a staggering indication of how common self-mixed projects are. To the question “Do you do all of the track mixing yourself?” 88 survey takers responded “yes,” and only 3 responded “no.” This particular study shows that the overwhelming majority of computer-based musicians do all of their own mixing. For close to a decade, mixing for professional projects had been an advanced technical task taken on by outside engineers and producers, only done in expensive studios. There is an arguable trade off with self-
mixing projects outside of a traditional studio. On one hand, these musicians do not have to spend money to book studio time for mixing; there is much more flexibility with the process; and ideally they can convey their songs sound exactly the way they envision. On the other hand, there may be an element lost by not having an experienced engineer providing a fresh opinion on a piece that someone brings into their studio and running signals through high quality monitor speakers and processing gear. Regardless, self-mixing is a very prominent trend with computer-based musicians and shows no indication of lessening in popularity. Recent advancements have made the transition to digital mixing more promising than ever.

**Cutting Edge Technology**

What computer technology is capable of now is spectacular. Two points, in particular speak to the modern capabilities of computer music software and their future direction: one, the likeable timbral characteristics imparted by analog hardware gear are now being well replicated through digital applications; and two, some virtual processors are capable of producing results that eclipse any analog device. Again, some of the previous issues people have had with using computer-based systems versus analog systems include slow speeds, low track counts and a cold sound. These problems continue to be overcome. New computer processor chips are quick and can drive music sessions with near zero latency, even when handling large amounts of information. Processors called plugins open inside DAW applications and are made to take on the roles of many different types of audio tools. They can be virtual instruments like synths, and samplers, dynamic processors, or effect processors. In a *Sound on Sound* article
entitled, “Plug-in Modeling,” Colin McDowell the CEO of plug-in design company McDSP, claims,

“Anything created in hardware can be recreated in software.” He goes on to say, “Writing software is a much more fluid engineering method and, by its very nature, more flexible than a fixed hardware design. Furthermore, the notion that ‘classic’ analogue gear is capable of doing something that the average computer cannot do is outdated. Limitations, if any, only exist in the imagination, experience and creativity of the engineer(s) making the audio plug-in” (Lambert, 2010).

These plugins are now extremely powerful. Many are being created to emulate the sonic characteristics of analog hardware while others are making advancement beyond previous limitations.

Plugins modeling hardware units are becoming very wide spread. Eddie Kramer is an audio engineer and producer who is credited in a massive amount of popular recordings since the 1960's, including most of the Jimi Hendrix and Led Zeppelin catalogs. In a demonstration with a representative of the plug-in design company Waves Audio, Kramer tests a plug-in emulation against the piece of hardware that it is emulating. Kramer states in a video interview,
“Once I heard the strict A/B comparison, I was very hard pressed to tell the difference between the two. There was a slight difference but I feel with a few more minutes worth of tweaking we would have got to the point where I wouldn't be able to tell the difference, which was very encouraging and very impressive.” Kramer concluded, “So what we've proven here is that it's very possible with just a little bit of work to very accurately match an original piece of hardware” (Waves Audio LTD.)

Plug-ins are emulating classic high-end EQs like Wave's emulation of a Neve 1073 (which Kramer tested), compressors like Universal Audio's emulation of their own 1176, or Lexicon's emulation of their reverb effects. However, not all high-end plug-ins are emulating analog pieces.

Some plugin manufacturers are using computer technology to push new boundaries. In the virtual processor category, plugin design company Isotope has a popular mastering system called OZONE, where users can enhance their audio using a maximizer, equalizer, multi-band dynamic compressor, multi-band stereo imager, multi-band harmonic exciter, reverb and dithering tool, all in one plug-in. The virtual instrument category has been significantly affected by advancement in computer technology as well. Cutting edge virtual instruments are generating tones that do not try to emulate sounds that analog synths would produce, they are expanding into new sonic territories.
In 2007, *Sound on Sound* published an article reviewing a product that began a trend to move virtual instruments into new realms. Author Simmon Price discusses the power of Native Instrument's Massive synth in his review stating,

“Massive is a soft synth that is going after the big boys of the modern hardware synth world, such as the Access Virus and Nord Lead families. Though capable of it, it is not trying to be an analogue modeling synth in the way these synths are. It has some of the flavor of the Virus, but its kinship is more with the modern-sounding hybrid synths” (Price, 2007).

This is an indication that computer technology is pushing sonic capabilities to new boundaries. These powerful virtual tools are very inexpensive in comparison to analog.

**Conclusion**

Computer technology is greatly influencing the creation of new music. Before approaching a computer workstation, the imaginative process of the musician plays an important role in determining how the project will unfold. The musician should consider who they are as a composer, who the intended audience is, and what they are hoping to achieve by creating their music. Computer-based musicians configure production rigs to compose and mix their projects. The computer is the central component, while extensions provide the ability to monitor and input data. Tools popular to computer music rigs are monitoring speakers, A/D converters, microphones and MIDI controllers. Creating the music itself is approached and developed different ways, but having solid
compositional skills is a commonality of successful computer musicians. Virtual instruments and processors available are extremely powerful and present many exciting possibilities. Analog gear modeled in a digital format is extremely realistic and virtual instruments are capable of producing tones that analog pieces cannot. Now is a fantastic time for computer-based musicians - the future seems to hold room for considerable positive development.


Image Cited:


