Is the Future of Music Generative?

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Executive Summary

Generative music was a term coined by Brian Eno to describe the music he created using SSEYO’s computer music software program, Koan\(^1\). Generative music is created by the composition of music within a system or process which means that musicians, artists, producers, and to some extent the composer, are absent from the creation process. The generative music composer, besides defining the musical parameters within the piece, essentially separates himself from the creation of the final piece of music. As musicians, artists and producers are superfluous to the generative music creation process the proliferation of generative music systems or processes to create music could have an affect on current music production processes and the people who work with them. Also, the intention of generative music is to produce a unique piece of music each time

\(^1\) Koan is examined in Section “Current Generative Music Related Applications” on page 248 of the article
the generative music process or system producing it is reset and therefore means that generative music in its purest form is not recorded. As it is not recorded no copyright subsists in the music produced by the generative music system or process. Because no music copyright exists within pure generative music the role of traditional music companies in relation to generative music such as collection societies, record labels and publishers, which rely on copyright subsisting within music to allow them to carry out their day-to-day business, is brought into question.

The aim of this report is to address this question as best it can: “Is the future of music generative?” In other words does generative music have the potential to change the structure of the music industry and the way in which people create and listen to music in the future? The question may be bold but it is one that needs to be addressed in order to ascertain the extent to which generative music could go to change the current situation and then lay the foundations for a structure that will reach that position. Recent history reminds us of the perils of ignoring the potential of technological advances in relation to music. The music industry largely failed to realise the potential of the Internet, dismissing it as merely a way for academics to offer and transfer information. As a consequence, the music industry has been struggling to cope with the Internet’s proliferation and the number of music-related applications and services that have appeared as increasing bandwidths have enabled music files to be exchanged over the internet with greater and greater ease. It would be unwise, therefore, to simply dismiss generative music as “just music made by computers”.

The report looks at the history of generative music, the validity of generative music as an art form, how generative music is produced and experienced and then looks at generative music releases. The next section of the report examines generative music and its relation to copyright then in the following section looks at its relationship with, and potential effects on,
traditional music businesses such as PRS, MCPS, PPL, publishers and record labels. Current generative music creation applications such as Koan and MadPlayer are then considered followed by a look at other cultural industries in which generative applications are present, where generative music systems are being developed and where generative music systems could be applied.

In its conclusion the report recommends that generative music systems be initially developed for “on hold” music services and public places and then as generative music is accepted develop generative music systems for the domestic environment and health services where music is used for therapy. The report also recommends that a new business model be developed in tandem with generative music systems to accommodate generative music and its creation.

**Introduction**

“Generative music is commonly agreed to describe music in which a system or process is composed to generate music rather than the composition of the direct musical event which will result from that system. The generative composer has only indirect control the final musical result, and the creativity of the compositional process is found in the decisions about how the system will operate and the rules inside the system”(Rich 2003, p 17).

The simplest example of generative music is the music produced by wind chimes. In this case the wind chime is the generative music system or process and craftsperson constructing and positioning the chime is the generative music composer. The craftsperson decides what the overall characteristics of the sound produced by the chime should be by the

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1. It is more likely that the positioning of the wind chime will be carried out by the subsequent owner.
materials that he uses to make it. Materials generally used to produce wind chimes are bells and metal rods with larger bells or longer metal rods producing lower notes and smaller bells or shorter metal rods producing higher notes. The craftsperson decides the size of the bells, the length of the metal rods that should be used and where they should be positioned in relation to each other. When the wind chime has been constructed the craftsperson (or owner) then decides where the chime should be positioned so that the wind can pass through it to produce music. This could be in a sheltered place where the wind is gentle or a more exposed position where the wind is stronger. At this stage the craftsperson’s influence on the music that the wind chime produces ends and nature takes over to produce the final piece of music.

The music produced by the wind chime is random. Computers have enabled generative music systems or processes to be created where the generative music composer has more control over musical parameters within the system or process and therefore the final music produced. Generative music software programmes such as Koan Pro, for example, enable the composer to have control over more than 200 musical parameters. In the wind chime example the musical parameters over which the craftsperson has control are the size and position of the bells, the length and position of the metal rods and the final location of the wind chime itself. Like other generative music systems or processes the wind chime produces music without the intervention of musicians, artists or producers. The fact that musicians, artists, producers and to a large extent the composers are absent from the creation process means that a proliferation of sophisticated generative music systems or processes could have a significant effect on traditional production methods and the people who currently work with them.
Another important aspect of generative music is that when a generative music process or system is reset whilst the overall characteristics of the music are similar to the previous piece of music produced by the system or process the actual music itself is different. Using the wind chime as an example again, if the wind chime was taken down and positioned somewhere else the characteristics of the music produced would be similar to the music produced in the original location but the actual notation of the music produced by the wind in the new position would be different. Because the intention of generative music production is to produce a unique piece of music each time the process or system producing it is reset this means that generative music in its purest form is not recorded. As it is not recorded, like the music produced by the wind chime, no copyright subsists in the music produced by the generative music system or process.

At the Cybersonica festival in 2002 John Eacott and Mark d'Inverno, from the University of Westminster, presented their ideas for iHiFi as part of the festival’s symposium. Returning to Cybersonica the following year I naively expected to see a further presentation giving updates on the progress of the development of the iHiFi project. Alas, the project was absent from the festival programme and had been assigned to the ‘interesting idea at the time’ bin, its instigators having moved onto other projects. This, to me, seemed a terrible shame. Here was an idea that with appropriate funding and development could be realised as a commercial product. To me the development of generative music-related applications such as iHiFi would offer the individual greater empower-

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1. iHiFi is a generative music system that is an extension of the domestic HiFi system. It’s aim is “provide music according to taste, mood and activity” (Eacott and d'Inverno 2002, p 2) and is discussed in more detail in Section “Generative Music Releases” on page 230)
ment to satisfy his or her specific tastes and choose exactly what he or she wanted to hear, when and where he or she wanted to hear it. Generative music would at last, I thought, free individuals from the tastes and clutches of record company executives ensconced in ivory towers and give them the freedom to make choices about what they wanted to listen to themselves.

This report sets out to explore the nature of generative music and its possible effects on traditional music business practices and the way that we create and experience music in the future.

The report looks at the history of generative music, the validity of generative music as an art form, how generative music is produced and experienced and then looks at generative music releases. In the next section the report examines generative music and its relation to copyright and then looks at its relationship with, and potential effects on, traditional music businesses such as PRS, MCPS, PPL, publishers and record labels. Current generative music creation applications such as Koan and MadPlayer are then considered followed by a look at other cultural industries in which generative applications are present, where generative music systems are being developed and where generative music systems could be applied.

There are many ways in which generative music can be produced. These include the use of random numbers to represent and change parameters within the generative system, by using Markov Chains and Neural Nets which are networks based on both randomness and choice. Generative music can also be created using Iteration systems such as Chaos, Fractal and Automata systems that carry out the same procedure continually taking the final output of the last stage of the composition as input for the next stage. Generative music is also created using data mapping tech-
niques by using inputs from external sources to influence the creation of
the music within the generative music system.

This report, however, will concentrate mainly on generative music cre-
ated using software programming environments such as MAX/Msp, Pure
Data, Supercollider and C++ where stochastic procedures, in which there
are both pre-programmed and random elements, are used in the creation
process and those which use data mapping techniques in conjunction
with these environments to create music.

The term ‘pure’ generative music is used in the report to describe music
that has been produced by a generative music system or process. The
term ‘fixed’ generative music is used to describe generative music that
has been produced by a generative music system or process and subse-
quently recorded. Where neither term is specified it should be assumed
that reference is being made to ‘pure’ generative music.

Generative music is an emerging field. While the Internet is populated
with articles about Brian Eno and Koan there is little academic study ded-
icated specifically to generative music. Academic institutions that do
devote time to the subject include Tod Machover’s team at Massachu-
setts’ Institute of Technology, John Eacott and Mark d’Inverno at the
University of Westminster, Andrew Gartland-Jones and Alice Eldridge at
Sussex University and Eduardo Reck Miranda at Plymouth University.
Of these institutions Westminster is alone in its interest in the develop-
ment of generative music applications that offer alternatives to conven-
tional commercial music applications and products.
History of Generative Music

“I’ve always been lazy I guess. So I’ve always wanted to set things in motion that would produce far more than I had predicted” (Eno 1996)

The earliest example of a generative system in music can be found in wind chimes of prehistoric times. The Aeolian Harp, first used by the ancient Greeks, was a more advanced generative system based on the wind chime where gut strings of different thickness are tuned to resonate in unison with each other. Rising and falling harmonies are then produced when air blows over them. W.A Mozart’s dice game, Musikalisches Würfelspiel, was the first generative system to involve notation. Within the game a series of short phrases are selected based on the roles of a dice and combined to form a two part waltz.

The composer John Cage was also interested in aleatoric or “chance music” compositions. His 1952 piece, “Four Minutes And Thirty Three Seconds”, was first performed by pianist David Tudor at Woodstock in the States. The score for the piece consisted of three movements in conventional notation with blank measures. Tudor lifted the piano lid to signal the beginning of the piece and lowered the lid after 4’ 33’ to signal the end. The content of the piece was formed from the random background ambience throughout the duration of its performance.

Not all generative systems are completely aleatoric. Serialist composers such as Anton von Webern used extreme mathematical precision to create their compositions. Steve Riech’s 1965 piece “It’s Gonna Rain” was created using six tape loops of varying lengths that were played to form a complex set of overlap points where combinations of the same ambient textures are rarely heard. In Terry Riley’s “In C”, the performer moves along at his own speed through 53 recurring figures creating a piece of varying length with a non-stop pulse, repetitive themes and interlocking
modal melodies. Reich’s tape works led Brian Eno to establish the compositional features and principles of ambient music. He then subsequently became interested in creating musical systems that produced music of infinite length that never repeated itself rather than linear works that had a fixed structure and time frame. His aspiration was realised when he received a copy of SSEYO’s Koan music software in 1995. Eno subsequently coined the phrase “generative music” to describe the music produced by the software.

Inevitably, and more recently, the algorithmic processes used to create generative music have been carried out using computers. A number of music programming environments such as MAX/MSP, Supercollider, and PureData exist to achieve this:

MAX/MSP is a graphical programming environment that was developed by IRCAM (Institut de Recherche et Coordination Acoustique/Musique) in Paris in the early 90s where users can create their own software using a visual toolkit of objects that are connected together using virtual patch cords (rand()% 2004).

The Supercollider programming environment was developed by James McCartney in the mid 90s. Now a free program since McCartney’s move to Apple, it uses “a text based object orientated language running inside a SmallTalk core with a graphic user interface creation tool and a simple help facility” (Rich 2003, p 22). The user is able to process audio in real time and create music applications, compositions, interactive performances and installations.

PureData is similar to MAX/MSP and was developed by Miller Puckette, one of the original team that developed MAX at IRCAM. It is another free software system with ongoing developments and releases. Slightly less user friendly than MAX it is a more open system that allows users to customise their software (rand()% 2004).

Director and its cousin Flash are commonly used to produce visual content for CD-ROMs and websites although they can also be used to create simple generative pieces.
C++, Java and Perl are powerful programming languages and can achieve a wide range of conceptually abstract possibilities. They are, however, difficult to learn and require high levels of skill.

**Experiencing Generative Music**

“What’s not hard to create ok generative music that gets 95% of the way to sounding good. The difficult part is to go the last 5% by making the algorithm clever” (Machover 1997; cited by Bunn 1997)

One of the questions often asked is whether the product of modern generative systems or processes can be described as music because they often rely heavily on computers to produce the music. Conventional music notation is a mathematical representation of music in the same way that generative music algorithms are a mathematical representation of music. The difference is that conventional notation is interpreted and performed by musicians and generative music algorithms are interpreted and performed by the computer with certain parameters within the software environment that creates the music being influenced by both the user or external environmental fluctuations converted into digital data.

Another question asked in relation to generative music, also because of its heavy reliance on computers, is whether the methods employed to produce generative music are merely technical and cannot be described as artistic. It can be argued that a programmer is engaged in a creative act when he is developing a generative system and that “programming is no less an art form than painting is a technical process” (Cox & Ward 1999).

Claims that generative music, therefore, lacks artistic credibility because of the absence of many aesthetic decisions made by the composer are becoming less and less relevant. So too are claims that generative music compositions are the merely activities performed by programmers and
technicians. The convergence of technology with art-based disciplines means that computers are becoming an integral component in the production of many forms of art. The technician and the programmer are the new artists in this age of technology.

Until the development of friendlier user interfaces for generative music systems current programming environments such as MAX/MSP, Supercollider and PureData will require advanced levels of skill and knowledge of programming to produce generative music. Koan, examined later in the report, is a simpler system to use but its output is seen to be limited to manipulating pieces pre-programmed by its development team (Eacott 2000). An accomplished generative music composer who uses programming environments like MAX/MSP, Supercollider and PureData is able to compose in “terms of gestures and middle level musical structures” (Pope 2004) enabling high level notations to be built without the need to write each individual notes enabling the program to “fill in the gaps”.

In comparison musicians who use linear music software programmes such as Acid, Logic, Cubase and Protools tend to get bogged down with infinitesimal details and consequently often find themselves ignoring or missing the bigger picture. For example, too much time and attention spent on achieving the right sound on, say, a rhythm track of a linear recording may affect the overall sound of the recording so much that original ideas or intentions for the overall recording are lost. Also unlike recorded music, generative music is non-linear but not necessarily always aleatoric or random music. In the case of the MAX/MSP, Supercollider and PureData programming environments stochastic procedures are often used to “integrate random choice into the decision making process” (Roads 1996). Current generative music systems, therefore, offer the tools and framework to sow “compositional seeds” (Eno, 1996) to produce music.
LISTENING TO GENERATIVE MUSIC

“I think it's possible that our grandchildren will look at us in wonder and say: ‘You mean you used to listen to exactly the same thing over and over again?’” (Eno 1996)

Listening to recorded music is a modern phenomenon. Before the arrival of the gramophone record in order to experience music most people had to attend a live performance to do so. The same piece of music was never exactly the same with each performance creating a different and unique experience for the audience. Modern linear recording of music lacks the variability of live music however much the sound technician attempts to create a “live sound” in studio recordings. Generative music contains elements of both modern linear recordings and live music. Although generative music is unlikely to substitute modern linear recordings and live music completely in the future it could become a viable third alternative when people consider how they are going to experience music (Eno 1996).

But can generative music compositions be enjoyed in the same way that we enjoy our favourite CDs? Although a generative music system produces a unique piece of music, each time the system is reset certain elements in the piece such as melodic or rhythmic elements that the system produces may appear in later incarnations and evoke the same feelings of pleasure and appreciation that the elements did the first time they were heard.

The common test of the validity of any linear piece of music is whether it passes the “humming test” (Eacott 2001). Melody is the component of a composition that listeners retain in people’s memory. Would the music produced by a generative music system stay in our consciousness and reappear as we find ourselves humming a piece later on? As equally important as the melody are the arrangement and sonic qualities of the piece that enable the listener to experience the energy and emotion of the
Experiencing generative music is more akin to listening to a radio station where the listener tunes into different stations to find music that he likes. He also has a certain amount of other interaction with other controls at his disposal such as volume, treble and bass. These basic controls by themselves can have significant affects on the listening experience.

The reoccurrence of elements that evoke memories of previous experiences of the music may not in fact be important. The real importance may lie in the skill of the generative music composer to consistently produce music that evokes feelings of pleasure on hearing the piece the first time round. The generative music composer should also aim to produce music that is accessible. Additionally, there needs to be an element of repetition and predictability in the generative composition together with variation to maintain the interest of the listener.

Gesture and spectacle disappear into the micro-movements of the laptop performer’s wrists and fingers. From the audience’s view the performer sits motionless, staring into the luminous glow of the laptop screen while sound fills the space by an unseen process”. (Cascone c 2002)

Conventional music is generally performed in a live environment to an audience by musicians playing conventional instruments. This could be anything from an orchestra playing in a large concert hall, a rock band playing in live venue to a solo acoustic artist playing in the back room of a local public house. In these live settings the interaction between the audience and performers together with the audience’s appreciation of the craftsmanship employed by the musicians are integral to the enjoyment and quality of the live music experience.
The appreciation of performances of generative music in a live environment is difficult. The main difficulties are the barrier that the position of the laptop in relation to audience makes together with the complexity of the programs that run on the machines to produce the music and people’s perception of lap top music in general. The audience may understand that some software programme is producing music but may not be aware that it is not simply a ready made sequencer (Collins 2003) that is performing this operation but a composer that is manipulating parameters within custom made systems or processes constructed using software such as Supercollider, MAX/Msp of Pure Data. To the uninitiated or disinterested there is nothing particularly dynamic or exciting about watching someone clicking a mouse or some other desktop input device attached to a lap top computer. To the initiated and interested the swift changes and manipulation of code real time may be as powerful as experiencing a live rock or classical concert. The generative music performer therefore can employ just as much skill in his craft as a lead guitarist in a band or solo violinist in an orchestra do in theirs in order to evoke a reaction from the audience, albeit to a minority section of the audience.

So how could the sense of excitement that the lap top performer feels as he programmes live be conveyed to the wider audience? One suggestion is to project the performer’s manual manipulations on a screen behind the stage to enable the audience to understand or at least appreciate what is going on behind the lap top lid to produce the music (McLean 2003; cited by Collins 2003). It is unlikely, however, that members of a lay audience will be even aware of many of the programs used by the performer particularly where live coding is used let alone understand them. Another more practical solution may be if the lap top performance were combined with a visual element such as live manipulation of graphics or video using programmes such as Jitter, GEM or Visual Jockey caused by
the music that the generative music performer produces. This will enable the audience to understand that the generative music performer is actually producing music behind the laptop screen because the projected graphics or video streams are being affected in real time by the music that they hear.

The interactive capabilities of computers also mean that control devices other than mice, which limit the performer to altering one slider or parameter within the programme at one time, could be used. Such control devices could also bring a human element to the performance. Gestural nuances could bring interesting dynamics and subtleties of phrasing and articulation to the performance. The performer may not only affect the electronic musical events but also the electronics could also affect the performance of the performer creating a human-machine symbiosis live on stage. By adding sensors the sounds of traditional instruments can be manipulated. Entirely new instruments can be also be built to interact directly with the computer.

A dancer, for example, could bring a more dynamic and engaging performance that is interesting enough to sustain the attention of the audience using control devices such as the Very Nervous System (Rokeby 1999; cited by Kieslar 2001) which detects movement with a defined performance space or the Control Suit (NOTHAM 2000; cited by Kieslar 2001) which is equipped with sensors allowing the performer to create sounds by tapping the body. Other control devices include the BodySynth (Van Raalte 1999; cited by Kieslar 2001) in which sensors detect muscle changes and the Midi Dancer system (Coniglio 2000; cited by Kieslar 2001) which uses flex sensors and a transmitter to send joint angle variations to a computer.
The addition of other elements in a live performance of generative music may create an unnecessary detraction of attention away from the expertise that the laptop performer not only has employed in creating the custom made programs that he or she uses but also the skill in which he manipulates the programs during a live performance. After all should the laptop composer even need to fall in line with convention and create a “memorable” experience for his audience? Maybe it is just a matter of education and the audience needs to adjust to experiencing a live performance aurally rather than visually in the same way that audiences had to adjust to new ways of experiencing music when the radio and gramophone arrived.

"Contents may vary" (Cover of Morpheus CD Rom 2001)

Morpheus is a Mac only CD-Rom of fluid dance music (Eacott 2001). Rather than an audio CD where the performance of each track is linear and fixed all the 16 tracks dance music tracks were programmed in Supercollider to enable a unique performance each tracks to be played when they were either selected or reset. Although the characteristics such as melody, instrument sounds, rhythms and arrangements are changed there is a recognisable thread running through the track each time a new version is played, rather like a remix (Eacott 2001).

Part of the brief for the Morpheus project was to produce tracks of a limited duration of between 3 and 8 minutes. It is unusual for a generative work to be time limited. It may have been more appropriate to either move on to the next track or another track randomly chosen every 3 to 8 minutes with some form of cadence to give a sense of separation between tracks. Morpheus is also non-interactive and has no graphic interface whatsoever. Again this is unusual as the one would expect the user to
have some control over the output of music such as the tempo, instrumentation or rhythm of the piece.

But is a physical release in the form of a CD-Rom in fact relevant to generative music? The music industry is finding that more and more consumers are turning to the Internet and buying mp3s through downloads rather than audio CDs which are quickly becoming an outmoded concept. The Internet is also an ideal medium for the delivery of generative music as the storage requirements are small and transfer of generative algorithms can be carried out over the slowest connections. Koan files for example are generally smaller than midi files and between 10k and 20k. Nevertheless, whereas “soft” players such as Realplayer and Winamp exist to play mp3s on PCs and Macs, neither a universal algorithm format nor soft player exist for generative music. If creators of generative music hope to utilise the Internet to distribute and profit from their work then both of these issues need to be resolved. The iHiFi project (Eacott and d'Inverno 2002) goes some way to laying the foundations for addressing these issues.

The iHiFi project proposes a generative music system that is both interactive and autonomous. The aim of iHiFi is “to provide music according to taste, mood and activity” (Eacott and d'Inverno 2002, p 2) in the domestic environment and be an extension of the conventional HiFi system. Through the use of sensors the iHiFi system would be able to detect and, based on information that has either been pre-programmed or gathered, even predict an activity or situation within the domestic environment and play appropriate music to suit that activity or situation. For example the system would detect that dinner was about to be served and play appropriate music for that activity. It could also detect the presence of a particular person within the environment and, based on information
that it held on that person’s preferences, play appropriate music for that person.

Through the development of a number of intelligent agents the system would be autonomous and be able to act without intervention, able to learn from its mistakes, respond to changes in its environment however small, be able to achieve long term goals through planning, be able to prioritise its operations, develop a social awareness or relationship with its users and those that they socialise with, communicate with other systems and be mobile. Agents would convert information about the environment and the user into mathematical data that would in turn affect the construction of the music produced by the system (Eacott and d'Inverno 2002).

Such parameters affected would include the instrument types, style, tempo, tonality and arrangements of the composition. Algorithms for compositions could be stored on a web based server ready for instantaneous download when requested by the iHiFi system as the environment around it changes (Eacott and d'Inverno 2002).

The development of a prototype for the iHiFi is a momentous task requiring the input of specialists from a number of different disciplines to achieve its aims. As an interim development and to pave the way towards the iHiFi system attention could be turned once again to the Mopheus project.

Instead of installing algorithms for generative compositions on CD-Rom algorithms could be installed on a web based server. In this way a database of generative algorithms could be built and developed on a central server enabling both composers to upload and users to download algorithms.
The addition of a software and graphical interface would enable the users to influence the type and order of compositions and also alter certain parameters within the composition. Additional inputs could also be added via an additional hardware interface that monitors fluctuations in the immediate external environment in much the same way that WeatherPlayer, an online audio installation designed by Owain Rich, does. WeatherPlayer uses data mapping techniques and interprets atmospheric conditions such as light, temperature, wind and humidity as sound. The development of such a system may be more manageable, requiring fewer resources and be an important precursor to the iHiFi.

**Generative Music and Copyright**

Copyright and the ownership of copyright are the essential building blocks of the music industry. Without them many organisations within the music industry would find it difficult, if not impossible to function. This section of the report looks at the issues of copyright and copyright ownership in relation to generative music.

The production of generative music poses interesting questions in relation to copyright ownership. Is the composer, and therefore copyright owner, the person who decides how the system will operate or is it the person who creates the system or process that creates the music based on those decisions? Also if the intention of generative music is to produce a unique composition each time the system or process is initiated or decisions changed within the system or process then there is no need for a hard copy of recording of the work produced. Along with the question of ownership this poses another question: when does the copyright in the work commence and also how long does it or should it subsist for. If the intention is to produce a unique title each time the system or process is
reset then would there really be any need for a term of copyright for that work to last any longer than its performance.

Section 9 (3) of the Copyright Designs and Patents of 1988 states that “the author of a computer generated work is the person by whom the arrangements necessary for the creation of the work are undertaken”. Section 11(1) goes onto say that author will be the first owner of the copyright work and Section 12 (7) reveals that the life of copyright of a computer generated work is 50 years from the end of the calendar year in which it was made. In the case of a generative work the author will usually be the owner of the software that produced the music.

This, of course, assumes that the work generated is recorded, however, the intention of generative music is to produce a unique work each time the generative music system or process is reset. The only exception would be if the work is synchronised to a film or television programme. Section 3 (2) of the Act tells us that copyright will not subsist in a work “unless or until it is recorded in writing or otherwise”. This includes making a video, tape, CD or digital recording of the work as well as a musical score. Therefore in order for copyright and therefore copyright ownership to exist, the generative work needs to be recorded. If it is recorded copyright will subsist from the time when the work is recorded, again Section 3(2) of the Act. Copyright will expire at the end of the period of 50 years from the end of the calendar year in which it is made, Section 12(7) of the Act as amended by the Copyright and Related Rights Regulations 2003. A separate copyright will exist in the recording of the generative work and will be last for a period of 50 years from the end of the calendar in which it was made. If the recording is released or broadcast within the 50 year period then copyright will be extended for a further 50 years.
Nevertheless, even if the generative work is recorded there could still potentially be a question about copyright subsisting in the work (Harris 2004). The “sweat of the brow” method used in the UK determines whether somebody has expended enough effort in creating a particular work and whether they deserve copyright. If it were proven that there was insufficient musical merit in the production of the generative work then the existence of copyright may not be justified. It could easily be argued that there is little music merit in producing a generative title. For example, the owner of the generative music system that produces the generative work has little influence on the musical output of the generative system or process save for decisions regarding the initial settings of parameters such as tempo, tonality, type of instruments and style. Therefore, despite the law indicating that copyright subsists in a generative work, if challenged, the courts could prove otherwise.

The implications of the absence of copyright and therefore copyright ownership in generative music in relation to the music industry are discussed in more detail in the next section.

**Generative Music and the Music Industry**

The authenticity of the “GM Manifesto”¹ of 2001 is debatable. It asserts that “generative music is a spectre that is haunting the music industry” with the established “old guard” of the industry forming an alliance to quash its existence. The Manifesto sees auto-generative systems as a threat to traditional music production, record companies and distribution. It also sees a time when advances in science and technology will also allow music to become self-regulating, self-generating and even self-cong-
suming with the consumer being “freed from the tyranny of the rewind/play button”. The previous section of this report revealed that the way in which generative music is produced raises interesting copyright issues. Whilst the generative world, predicted by the authors of the GM Manifesto, may be a long way off this section looks at how copyright issues and developments in auto-generative processes, or rather generative music systems, could affect some of the businesses in the music industry.

**COLLECTION SOCIETIES**

**PRS.** The Performing Right Society Ltd (PRS) is a non-profit making body that administers the “performing right” of some 38,000 members which include composers, songwriters, lyric authors, arrangers, music publishers, and successors to estates of deceased members. The “performing right” means the right to either perform a work in public or “communicating” the work to the public which includes broadcasting, broadcasting on demand, use of music on the Internet, interactive services and the inclusion of a work in a cable or satellite programme service. Film synchronisation right in any musical work specially written by a member for a film is also controlled by PRS.

Writers (composers, lyric authors, songwriters and arrangers) may join PRS provided one of their works is either performed live in public or broadcast and proof of the performance or broadcast has been submitted. Proof of a broadcast within a programme in a television or radio broadcast, cable or satellite transmission should be presented in the form of a letter from the programme producer. Proof of a live performance can either be in the form of a concert programme detailing the performance or a set list signed by the venue promoter or owner where the performance took place.
Clearly, although a generative work may have been performed in public, because copyright does not subsist in a pure generative work then the generative music composer has no rights to assign to PRS. If the work was performed in public and simultaneously recorded then copyright could exist provided that no-one undertook to prove that there was insufficient musical merit in the production of the generative work in the first place to justify the existence of copyright. As mentioned in the previous section, a question might be raised as to how much “sweat of the brow” had been employed by the generative composer in order to create the new generative work. To a large extent this would be dependent on the generative music system or process used to create the work. It might be argued that a composer who had created a work using a system or process where only a few parameters such as rhythm, instrumentation, volume or tonality could be manipulated had employed little sweat of the brow and so copyright in the work could not be justified. Conversely, the copyright in a generative work that had been created using a more complex system or process such as a SuperCollider could be justified. The generative music composer would then be eligible to join PRS and allow it to collect outstanding royalties on his behalf for the performance of the work. If the same generative piece is performed again the newly performed work may be considered as an arrangement of the original recorded work and therefore the generative music composer would be entitled to receive further royalties for that performance. Similarly copyright may exist in a generative work that has been included in a programme that has been broadcast, provided that it does not undergo the same aforementioned scrutiny with regard to the validity of copyright, and royalties would again be payable to the generative music composer.

The owner of a copyright work is entitled, by law, to receive payment from the music user when the work is played in public. PRS licenses both
“communicators” (which includes Internet sites and television and radio broadcasters) and the public places that play its members music in return for a royalty which it then distributes to its members after deducting an administration fee. Public places include pubs, bars, hotels, shops, restaurants, cafes, offices, factories, leisure and fitness facilities, health practices and clubs. Any public place that has a jukebox, CD or video player, radio, TV or puts on live bands or discos and plays copyright music is required to have a PRS licence. Of the £265 million revenue collected by PRS for the year 2002, £98 million and $84.6 million were attributed to UK Public Performance and Broadcasting respectively.

The immediate benefits to owners of users of “on hold” music¹ for telephones and public places² that normally use music in the background to create an ambience in their premises by installing a generative music system to play music are that they would be exempt from having to obtain a PRS license because the music played through the “on hold” music service or in the venue is non-copyright and also the owner would also have more far-reaching control over the music played. The adoption of a sophisticated generative music system by companies that normally use music for “on hold” services and in public places such as pubs, bars, hotels, shops, restaurants, cafes, offices, factories, leisure and fitness facilities, health practices and clubs could therefore have a significant affect on the revenue collected by PRS for Public Performance.

The immediate benefits to both radio and television broadcasters are not clear. It is true that a radio station would benefit financially by being exempt from paying a PRS license fee if it played only pure generative music. A commercial radio station needs to generate income by attracting

¹. See also Section “On-Hold Music” on page 254
². See also Section “Film” on page 258
Advertisers look closely at audience figures when determining how to allocate their budget for an advertising campaign and it is unlikely that large audiences will be attracted to radio stations that played only generative music in the short term as audiences would be more inclined, for the moment, to gravitate towards radio stations that play music that is familiar to them. Additionally, the PRS license fee payable is also based on the amount of advertising revenue that a commercial radio station receives and therefore if the revenue decreases so will the benefit to the radio station for using a generative music system.

A television broadcaster could be exempt from paying a PRS licensing fee provided it included only generative music in the programmes and films that it broadcast and provided that it could also successfully prove that although the work had been recorded there was little merit in the work to justify copyright. This is an extremely unlikely scenario certainly in the short term. Firstly, the broadcaster may not have any control over the musical content within the programmes and films it broadcasts because they are either imported or produced by external television and film production companies. Secondly, the broadcaster may be wary of using such a system because it may feel that the quality of the music within its programmes and films may be impaired and therefore have an effect on its audience ratings which in turn will have an effect on income received from advertisers. The benefits of being exempt from a PRS licensing fee may be outweighed by these considerations particularly when the licensing fee charged by PRS is proportional to the amount of advertising revenue that the broadcaster receives so if the advertising revenue decreases so will the benefit to the broadcaster for utilising a generative music system to create music for its programming. Until such time as a sophisticated generative film and music system is developed it is
unlikely that generative music will have a significant effect on PRS broadcasting revenue.

**FIGURE 1. Table 1 - PRS Revenue 1999 – 2002**

![PRS Revenue 1999-2002 Chart]

In relation to PRS, therefore, the generative music composer would be entitled to receive income as a member of PRS from the live performance of works if the works were simultaneously performed and recorded in public or income derived from the inclusion in a programme that was “communicated” to the public. Conversely, the owner of a public place that owned a system that only played pure generative music would be exempt from obtaining a PRS license. Benefits, other than financial, for owners of public places from adopting a generative music creation system are discussed further on in Section 8 d) of the report.

**MCPS.** The Mechanical Copyright Protection Society (MCPS) is given the exclusive authority to act as an agent on behalf of its members and license their works where they are copied, issued to the public or rented or lent to the public and synchronised to a television or radio programme and broadcast to the public. Its membership currently stands at around
16,000 members of which 11,000 are writers and 5,000 publishers. Like PRS, MCPS licenses its member’s works in return for a royalty which it distributes to its members after the deduction of a commission fee.

Of the £221 million distributed to its members in 2002 some £166 million was attributable to audio products. Another £7 million was attributable to new media.

**FIGURE 2. MCPS Revenue 1998 to 2002**

A generative music release such as the CD-Rom version of Morpheus would not fall under any of the Society’s normal audio product licensing schemes or indeed under any of its media licensing schemes. The music for Morpheus is produced by a software program and because the music is not recorded no copyright subsists in it. If conventional composers migrated from traditional linear music production techniques to generative music production techniques a proliferation of releases like Morpheus would have a significant impact on the mechanical income received by MCPS under its audio product licensing and media licensing.
schemes. Whilst MCPS would no longer benefit from the commission it normally takes for licensing works on behalf of its membership the main impact of the potential loss of this income would be incurred by the composers.

The algorithms created to produce the generative music, however, are fixed and as such copyright exists in them as a “literary work” (Hardingham 2004). The generative music composer can therefore assign rights in the algorithms created. This means, for example, that a generative music composer who supplies algorithms for use within a generative music release such as Morpheus would be able to conclude an agreement with the producer of the physical product in order to receive a royalty each time a copy of the CD-Rom was sold. As previously discussed it is more likely that generative music will be distributed via an Internet based generative music system rather than a physical product. The same principle would apply whereby the generative music composer would be able to conclude an agreement with the owner of the generative music system and receive a royalty payment each time the owner of the generative music system received income from the exploitation of the algorithms supplied through that system.

Ringtones are becoming an increasingly important source of revenue for MCPS and is included under new media income. Generative ringtones are copyright free and therefore exempt from the licensing schemes that MCPS operates and indeed PRS operates. Just as algorithms can be assigned to the operator of a web-based generative music system algorithms created specifically for a mobile generative system can be assigned to a mobile operator and thereby ensure that royalties are paid to

1. See also Section “Mobile Devices” on page 253

the generative music composer each time the algorithm was selected by a mobile device user.

If a generative work were synchronised in a feature film or television film or programme then royalties could be payable to the generative music composer under its media licensing schemes for feature films or blanket broadcasting licenses and if the programme or film was subsequently released on video or DVD the generative music composer would expect further royalties from sales or pressings of those releases. That is provided, of course and as previously discussed in the previous section, the question of musical merit to justify the existence of copyright had not been raised.

If the question of musical merit was raised by a broadcaster or film producer that used a generative music system to created music for its films or programmes then they may find themselves being exempt from payment of a licensing fee because no copyright subsisted within the works used. Again, as previously discussed, it is unlikely that a broadcaster would adopt a generative music system to produce music for its programmes in the near future. The same scenario may not necessarily apply to film producers. Jon Pettigrew uses Koan Pro¹ to create music for his films and generative music systems offer an ideal source of music for amateur film makers or other film producers making experimental films. In the short term and until the development of a sophisticated generative music system is produced, it is doubtful whether there will be a significant reduction in the broadcasting, video and DVD reproduction revenue streams that MCPS receives.

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¹ Both the films of Jon Pettigrew and Koan generative music software are discussed later in the report.
PPL. Phonographic Performance Limited represents both independent and major record companies. On behalf of its 3000 members it collects license fees from broadcasters which include both analogue and digital radio and television cable, satellite and Internet simulcasts and public places which include suppliers of music to businesses such as jukeboxes and background music systems or services and also businesses that play recorded music on their premises which include night-clubs, pubs, hotels, restaurants, shops and the work place. The revenue received is then distributed to both its record company members and to performers. In 2002 PPL distributed a total £61.1 million.

A company that uses “on hold” music services or an owner of a public place that had only a generative music system to play music would be exempt from paying a licensing fee to PPL as no master recording would be played. As with PRS, the adoption of advanced generative music systems by users of “on hold” music and owners of public places where recorded music is normally played could have a significant affect on revenue collected by PPL for public performance.

If, however, a television broadcaster included a generative music piece in a programme and even if it was argued that that generative work included in the programme lacked enough artistic merit to warrant copyright ownership in the composition a master recording of that generative work would still exist and therefore a license fee would be payable to PPL.

PUBLISHING COMPANIES

The role of music publishers is varied. It can include finding and supporting new and talented songwriters and composers whilst developing their writing skills. It can also include registering titles with MCPS and PRS, ensuring that money flows through correctly, at appropriate times and making payments to its songwriters and composers. It can mean promot-
ing and licensing its catalogue to broadcasters, record companies and others who use music on a commercial basis and producing demos to promote its songwriter’s songs to performing artists.

In order for a publisher to function it needs a strong copyright structure in place that enables it to be remunerated financially for the efforts it takes in promoting its songwriters’ and composers’ works and also the financial support it gives them. Without a flow of royalties the music publisher would find it extremely difficult to function.

The services of the publisher are unlikely to extend to the generative music composer. Firstly, copyright will not subsist in the majority of works that generative music composer creates. Secondly, for those compositions which may have been recorded and in which copyright does exist they may be susceptible to scrutinisation as to the validity of the copyright status and therefore the publisher may find itself without copyrights with which to trawl back the investment made in its generative music composer. The publisher may also find that because the intention of generative music is to produce a unique composition each time the system or process creating it is reset then the works that it does retain that have been recorded and have copyright subsisting in them may be worthless anyway. This is because the generative music composer may not think that the exploitation of what he or she might term ‘outdated works’ fit in with his or her ideas about ‘creativity’ and ‘art’ and may therefore use his or her ‘moral right’ to oppose any exploitation that the publisher proposes.

**RECORD LABELS**

Traditionally, of course, labels have made money by selling records. More recently the widespread use of the Internet has lead record labels to offer digital downloads to consumers. It is difficult to imagine how the
A New Business Model for Generative Music?

While the generative music composer has a number of possible royalty income streams no one traditional music business is equipped to accommodate the needs and interests of the generative music composer. Although the generative music composer could collect royalties directly himself, the collection of performance and mechanical income from the exploitation of fixed generative music works could, in theory, also be undertaken by a publisher if the generative music composer agreed to such exploitation considering that fundamental principle of generative music is to produce music that is different each time the system producing the music is reset. The publisher would need to understand the principles behind the production of generative music and establish the

1. It is worth mentioning that in the course of research for this report no instances have been found where the use of generative music techniques within compositions created by artists have led to validity of copyright in the piece being brought into question.
generative music composer’s feelings on fixed generative music before embarking on a relationship with the generative music composer particularly where the publisher needs to recoup any advances it has made to the generative music composer.

The collection of royalties accrued from the exploitation of the algorithms that the generative music composer creates could also be undertaken by the publisher. The collection could equally be carried out by a record company or, indeed, any company that has an accounting system capable of distributing royalties on a regular basis. The distribution of the generative music composer’s algorithms is likely to be made via a web-based generative music system in the future. It is therefore likely that any agreement concluded between the generative music composer and the owner of the generative music system will make a provision for royalty distribution directly to the generative music composer and therefore there will be no need for the services of a publisher, record company or other third party to collect on behalf of the generative music composer. The generative music composer would simply have to employ the services of a lawyer to negotiate any agreement on his behalf to assure that fair, regular and accurate accounting is made to him or her.

The generative music algorithm is an important consideration when laying the foundations for a generative music system. Both PPL and PRS have been lacklustre in their efforts to embrace advances in technology in order to create a system that can identify individual public performances of works by their members preferring instead to refer to other data such as chart information to help them allocate license revenue. The consequence of this attitude is that many members of PPL and PRS fail to receive royalties to which they are entitled. The development of a generative music system would incorporate a watermarking system that would
The way in which generative music is produced and likely to be distributed may call for new business model to be created to accommodate it. The relationships that the generative music composers build very much depend on whether the music produced is entirely pure generative music or whether there is also the intention to produce fixed generative music. The development and proliferation of generative music will depend on the development of a generative music system and where that system might be used and by whom. In the meantime the generative music composer would be well advised to seek the services of a manager who not only understands current music industry practices and the processes involved in creating generative music but also has the ability to seek opportunities on behalf of the generative music composer and also the adaptability and foresight to navigate the generative music composer through the inevitably difficult times ahead during the development of generative music and generative music related applications.

Current Generative Music Related Applications

KOAN

“Ordinary music is like engineering, where everything’s built according to a plan, and it’s the same every time you play it. Generative music is more like gardening; you plant a seed, and it grows different every time you plant” (Eno 2001; cited by Shachtman 2001).

Of the ready made user friendly generative music packages on the market the Koan Pro is the most popular. The development of Koan started in 1986 when SSEYO founders Tim and Peter Cole decided that they “wanted to create a computer system which could affect you on an emotional level, by enhancing or filtering your perceptions, and provide ever-
Changing, eventually interactive, music” (Garton 1996) The Koan Music Engine (SKME) was launched in 1990 which according to parameters set by the composer allowed composition and harmonisation of music in real-time.

When Brian Eno received a copy of Koan in 1995 and heard the results he was so impressed that he started working with Koan Pro and released Generative Music 1 on floppy disc in the following year.

Koan Pro produces music that constantly evolves and never repeats itself. The outcome of each piece of music is affected by the value of over 200 user-defined parameters which include these include timbre, sound envelope, scale, harmony, rhythm, tempo, vibrato and pitch range. Although users are encouraged to interact with the parameters to create a unique piece of music what is achieved has been described by some users as simply a remix of pieces pre-programmed by the Koan development team (Eacott 2000).

The free Koan Plug allows playback of Koan Pro music files automatically via a webpage or browser. It also allows web animations, such as Flash, to be driven by Koan music and MIDI files. When it was released in 1999 the small file sizes, typically 1k to 20k, enabled a better experience for users using Internet connections with low bandwidths. With the increasing availability of higher bandwidths the issue of file size is not quite so pressing when browsing using an ADSL 1.2Mb bandwidth connection.

Development of Koan ceased after the release of Koan Pro 2 and following the acquisition of SSEYO in 2002 by the mobile technology Tao which is owned by Motorola, Sony, NEC and other Japanese consumer goods companies. Tao’s focus has been generating revenues from mobile
phone applications. The Koan music engine became incorporated within Tao’s intent Sound System (iSS) that will be examined later in the report. There are plans to release Koan Pro 3 but this will primarily be a tool to produce generative content for mobile device applications (Cole 2004).

**MADPLAYER**

MadPlayer was launched in the UK at the Ministry Of Sound in May 2002. It is described as a “Generactive hand held music player/recorder”. The word Generactive was created to capture the essence of MadPlayer: “copyright-free music you can create (generate) and then play with (interact with)” (Madwaves c 2004). Its initial retail price of £250 has dropped and it is now available from Madwaves’ website for a price of £99. MadPlayer has a soundbank of 550 instruments and sounds and uses its ‘Generative Music Algorithm’ software to create a limitless stream of unique music. By means of a simple graphical interface users can choose between, mainly, dance-based genres such as techno, house, garage, hip hop, RnB and ragga and then change aspects of the music on drum, lead lines, bass, riffs, samples and voice tracks. Pitch and tempo can also be altered by using a joystick and effects added using effects buttons. It does, however, lack the ability to enable cross pollination of genre types, something that would be expected from a generative music device.

Madwave rightly describes the music produced by MadPlayer as being as copyright free. What it does not explain is that copyright would subsist in the music produced if it was subsequently recorded and the copyright owner of both the composition and master recording would be the owner of the MadPlayer, assuming that it was the owner that recorded the composition.

MadPlayer clearly illustrates the lack of creativity actually needed by the user in order to create music. The user simply selects music that is appro-
appropriate for his listening tastes and preferences by a process of elimination in much the same way as someone tunes a radio to find a frequency that plays music he enjoys. The creative talent is to be found in the programmers that create the algorithms used in MadPlayer.

MadPlayer is seen primarily as a toy among serious creators of music aimed at people who would normally listen to CDs or the radio rather than create music from scratch. It could also easily provide background music for low budget film or television programmes.

**GARAGEBAND**

“GarageBand is snoozeware for the iPod generation who think that music comes in a small white-and-chrome can and only needs to be served lukewarm for public consumption” (Casone 2004; cited by Kahney 2004)

GarageBand is the baby brother of Emagic’s (now Apple) Logic Audio, a professional music creation and audio production application, and Soundtrack, an audio for video application that was the first to support Apple Loops. It is not a generative music system but is included here to illustrate, again, that a user without musical aptitude can create music using a simple graphic interface. In fact what sets it apart from previous loop based music creation applications is its ease of use. GarageBand comes as part of Apple’s $49, i-Life package which includes iMovie, a video editing suite, iTunes, a music management application, iPhoto a photo management and editing suite and iDVD, a DVD creation suite.

Unlike generative music systems, Apple’s GarageBand is loop based. Over 1000 copyright free Apple Loops from a number of different genres are included with the package and another 2000 are available in a separate Jam Pack for $99. Selected loops are placed in a time line and any of the 200 effects available added to individual loops or whole tracks.
Although users are able to adjust the tempo and key of the loops GarageBand can do it automatically.

Audio files are output as AIF files only which can then be converted in iTunes to MP3 files. Music produced can also be easily imported into the iMovie and iPhoto applications. Again, no mention is made of the implications on copyright if music created were subsequently recorded. This is probably because Apple wants to avoid a deluge of requests for licensing agreements from GarageBand artists wishing to sell their creations via its iTunes Music Store.

Clearly with a price tag of $49 Apple’s intention is not to profit from sales of iLife but be a loss leader to drive the sales of its computers, iPods and other hardware and software that both it produces and by third party manufacturers that it sells via its store. It’s a strategy Apple has employed with success before. By selling songs with tight margins on the Internet via its iTunes Music Store for 99c, Apple’s intention was to sell more iPods.

Both the interfaces for GarageBand and MadPlayer are simple to use and allow someone without any musical ability to effortlessly create music. It must be only a matter of time before the novelty of making music on both GarageBand and MadPlayer wears off. When users realise that they are not really creating music but either simply playing it or remixing a generic version of music already in existence, they may turn their attention once again to more passive forms of music entertainment. They may also find that they want more control over the music that they listen to and look for play back devices and systems that offer similar control that they experience with GarageBand and MadPlayer, systems such as the iHiFi project proposes for example.
**TELECOMS**

**Mobile Devices.** Generative ringtones do not immediately spring to mind when thinking of ringtones for mobile devices. Tao’s Tim Coles, who was a founding member of the SSEYO the company that developed Koan, believes that “customers are becoming increasingly sophisticated in their demand for personalised audio on their mobile phones” (Cole 2003; cited by Business Wire 2003). Generative ringtone engines give the user the ability to produce a unique ringtone or “Live Tone” for their mobile devices on the fly.

Tao’s Advanced Polyphonic Ringtone System, intent Sound System (iSS), uses Koan’s generative music engine enabling the generation of ringtones in real time and has been employed in Microsoft’s Windows Smartphone. Tao have also developed Koan Interactive Audio, for Pocket PC software developers for low bandwidth mobile applications. The advantage of using Koan’s technology is that music can be produced with relatively few controls and small file sizes, file size being a major consideration for mobile devices. Another clear advantage of using a generative music engine to produce ringtones in general is that neither an MCPS nor PRS licence is needed by the mobile companies because the ringtones produced are copyright free.

Since SSEYO was acquired by Tao their attention has been to focus on the mobile sector and the completion of iSS. With work now complete Tao is developing further mobile audio applications for Smartphone and Pocket PC that will include Koan’s generative music engine. They also intend overhauling Koan Pro 2 and releasing a new version that will create generative content for mobile device applications. There are no plans at the moment to develop mobile generative music authoring tools but if the market demands such an application they will do so (Cole 2004).
MadWaves is currently Tao’s only competitor in the mobile generative ringtone applications market. Its Madmixer gained second place in the Ericsson Mobile Application Awards for 2003. It uses the same principles as MadPlayer to produce customised polyphonic ringtones by allowing the user to change various settings such as style and components such as drums, bass, lead, riff instruments. Its MadTone Generator also enables an infinite number of ringtones to be generated at the touch of a button. There have been no further press releases since MadWaves announced the Ericsson award. Naturally one would assume that Madwaves would be keen to publicise efforts it has made establish relationships with mobile device manufacturers to deploy its generative ringtone applications in the same way that Tao has.

If efforts to deploy a standalone generative ringtone engine by MadWaves with mobile device manufacturers have in fact been unsuccessful this may indicate that Coles’ belief that people are becoming more sophisticated in their demand for personalised audio and looking towards generative ringtones may not completely be justified. Indeed, the success of deployment of Koan’s generative music engine in mobile devices may merely be on the back of other applications within iSS and be considered as an add-on that people simply ignore.

**On-Hold Music.** On-Hold music is an important tool in keeping customers on the line while waiting for an operator or customer services assistant. Studies have found that callers are likely to think that they have been forgotten if there is no music on the line and that music reduces the perceived waiting time (Areni 2003) with callers staying on the line up to 20% longer if they heard music that they liked (PRS 1997). Studies have also shown that callers tended to hold on longer if jazz, country or classical music was playing rather than pop or relaxation music (Ramos 1993)
and that the choice of music played influenced the callers’ image of the company (Areni 2003).

PRS recommends that companies that use on-hold music change the music regularly, match music to customer profile and choose music to represent the desired company image. They also recommend that companies be unique in their choice of music and to focus on the value to the company by using the music and not the cost (PRS 2004).

While a system has yet to be developed, the immediate advantage to companies using a generative music system to produce on-hold music is that there is neither a PRS or PPL license fee payable as the music played is copyright free. The second advantage is the adaptability and variability of generative music. At its simplest a generative music system could play an endless stream of continually evolving jazz music to encourage the caller to hold or play music that is tailored to the caller’s individual tastes. This could be triggered by the telephone number used to contact the company and based on information about the caller that the company keeps on its customer profile database. Whatever genre of music is played there should also be an air of familiarity about it as “familiar music produces more discrete events in the memory than unfamiliar music thus increasing a person’s estimate of time” (Areni 2003). In other words music that is familiar to the listener makes time seem to pass quicker than when unfamiliar is played.

**GAMES**

“Good songs that repeat themselves over and over are a kind of psychological torture that only our modern culture could produce” (Harland 2000)

Until recently music in games had taken a back seat to its graphical content. As technology has advanced more game producers have been look-
ing towards interactive music to enhance the game player’s gaming experience.

Early attempts at creating interactive music for games were cumbersome. Digitally recorded songs were simply played in the background of the game and were interchanged when game play changed. This often resulted in unsubtle gaps between tracks when they changed and rather than enhancing game play made game play unpleasant. Creating music for games in this way was also both memory and storage heavy, important considerations when producing video games where disk space and processing power resource allocation are critical. Later attempts at interactive gaming fared better in games such as Rez where the gamer’s game play influences the composition of the game’s soundtrack.

For games producers the advantages of having interactive music in games are adaptability and variation. Non linear music within the game can change according to changes within the interactive media. Rather than creating a general atmosphere or mood as a bed, interactive music makes the interactive gaming experience even more immersive. Non linear music is also able to vary itself and be different each time the interactive media is experienced. With linear music the same audio file is played over and over again. Repetitiveness drives the gamer to turn down or turn off the music. Interactive music, however, has a disadvantage: it can produce random, inappropriate music if not programmed or managed properly.

Microsoft’s DirectMusic Producer (DMP) is free application that allows interactive audio content to be developed for games, for the web or, indeed, any interactive medium. DirectMusic allows the games composer to vary the game soundtrack by creating multiple paths that it can follow, varying chords, having alternative melodies or sound effects, enabling
the rhythm to be changed and increasing or decreasing the intensity of the music. It also enables soundtracks to be linked to specific events or states within a game (Microsoft 2004).

Generative music, too, satisfies the criteria needed for interactive music in games: adaptability and variability. The main flaw with DirectMusic is that it only supports general Midi information unless DLS (Downloadable Sounds) Instruments are used. DLS Instruments, however, are very memory intensive within interactive applications (Bridgett 2002). Generative music is not memory intensive at all and file sizes are minuscule in comparison to audio files.

But are memory and disc space important enough considerations to drive a groundswell of interest in producing a generative audio application for interactive media when DirectMusic seems to satisfy all the other criteria for interactive games audio and technological advances continue to produce faster and faster processors and higher and higher density disc storage? The answer, certainly in the short term, is no. Even though a generative audio engine would bring financial benefits to games producers because they would have to spend less money on commissioning fees for games composers, even the most innovative games producer would need a great deal of convincing before taking up the challenge of developing a generative audio system specifically for games. Furthermore, games composers are recognised as the principle drivers of new technology not games producers. Games composers continually need to keep up to date with technologies for their profession and communicate their needs to manufacturers so that they can guide technological developments in the direction that suits them (Bridgett 2002).

A particularly large section of interactive music composers dissatisfied with DirectMusic would be needed in order for a games producer or soft-
ware development company to take up the challenge and build a generative audio engine for video games. And besides DirectMusic has one advantage that any company developing such a product would struggle to compete with certainly in the short term due to the inevitable costs of developing the product and establishing that product in a market already dominated by another: DirectMusic is free.

**FILM**

Generative film is an emerging area of generative art and two possible models for generative film have been identified (Lobb 2003). The first is the ‘database movie’ (Manovich 1998) where pre-recorded film clips from a database are automatically sequenced to produce a film in real time. The crucial element of this approach in order to produce a generative film is the way in which the editing algorithm is created to define how the clips brought down from the database are meaningfully connected. The aim of generative film is not to produce a linear piece and does not require the author to place material in any particular order. The second model is ‘microworld’ which is produced using computer simulated characters. Algorithms and autonomous agents dictate the way in which the characters should interact. The audience then constructs a narrative themselves through the characters’ interactions.

Examples of the database movie can be found in the works of Lev Manovich and Stan Douglas. The nearest example of a microworld type film can be found in the video game “The Sims” (Lobb 2003).

Sam Woolf’s Googlegogglebox (2003), programmed in Macromedia’s Director, is a basic example of a database movie that can produce some surprising results. The user inputs text and then the program carries out a search of the Internet for images and audio files containing that text using both Google and Lycos search engines. When a specified number of files
have been retrieved. GoogleGogglebox renders the images and audio to produce a film.

There are examples of generative films that do not fit comfortably into either of the models identified by Lobb. “Reflections in the Water” (2002) by Jon Pettigrew, who was involved in development of Koan, and Russell Blakeborough, uses a traditional film narrative but intersperses the film with a “variety of different sequences in the water and other images from the life of Debussy” (Pettigrew 2002). Sequences of the film are previewed in VJamm, a real-time audiovisual sample player, to check for continuity, edited in Director and then exported to QuickTime. The soundtrack for the film was created using Koan Pro. Pettigrew also employed a similar technique to produce his generative film of a dance piece choreographed by Danielle Clarkson which she performed together with Karen McBride. There are plans to develop an audio visual engine which automates the current manual process that is employed to produce the films using the technology implemented by SSEYO in Koan and by Cambridge Art in VJamm to produce films with a multitude of results (Pettigrew 2004).

Alex Evan’s generative films use traditional pre-rendered animation together with generative animation. In Tom Thumb (2002) only certain details in the animation and elements of the music are randomised during each rendering of the film. A statistical technique known as ‘Markov Chains’ is used to rearrange the narrative of Tom Thumb which results in a text “which sounds vaguely English but makes little sense” (Evans 2002). The first half of Evans’ next film “Staying Pictures” (2003) is a film of traditional pre-rendered animation. In the second half of the film the animation changes with each render and the soundtrack is a linear recording.
Jon Pettigrew is about to test a film which is a cross between the database movie and microworld film. The film uses a personality engine to define interactions between the two main characters and then appropriate video clips are pulled down from a database to create alternative narratives (Pettigrew 2004).

Undoubtedly, until a generative audiovisual generative film engine that Pettigrew proposes to develop materialises music used within generative films will continue to be linear even if it is created using a generative music software program such as Koan or a generative music software programming environment such as SuperCollider or MAX/Msp and therefore be fixed.

PUBLIC PLACES

Many studies have been made to examine the effects of music and their characteristics on consumers in retail environments, restaurants and bars.

The style of music played, for example, creates an image of the establishment in the mind of the consumer. While classical music creates an up market image for an establishment it is thought that jazz music attracts a more affluent customer (Areni 2003). In another study customers in a cafeteria were found to be more willing to pay a higher price for food when classical music was playing in the background than other types of music (North & Hargreaves 1998). In the same study it was found that both classical and pop music may have increased the sales in the cafeteria as compared with easy listening and silence. Classical music was also found to appease rowdy or aggressive behaviour in customers whereas heavy metal was found to have the reverse effect (Areni 2003).

The tempo of music also has an effect on consumers. In one study fast music was found to significantly increase the time spent drinking a can of pop (McElrea & Standing 1992). Managers of restaurants also tend to
play faster music at lunchtime and in the evening to clear tables more quickly as diners tend to eat quicker when faster music is played (Areni 2003). Additionally, fast music was found to increase both productivity and morale of employees occupied with monotonous work. In a study at a voucher processing centre for a bank, fast music lead to 22.3% more vouchers being processed than when slow music was played (North & MacKenzie 2000).

The style and tempo of the music played in an establishment, however, is less important than the volume of the music played when considering the consumption of drinks in an establishment; for example, music played at low volume tends to increase expenditure on the product (Sullivan 2002). In fact music tends to be most effective when it is quiet enough to be discrete but loud enough to suppress background noise (Areni 2003). In general music reduces perceived waiting time, can facilitate conversation and alleviate uncomfortable silences (Areni 2003).

The use of music in the workplace to increase staff productivity, morale and communication is not a recent phenomenon. In the 1940s, an American company, Muzak, developed Stimulus Progression programming, an "elaborate system that arranges songs according to tempo and time of day, taking into account the typical lulls that hit workers mid-morning and mid-afternoon" (Davies 1996; cited by Garton 1996).

The development of a generative music system could also bring significant benefits to retail environments, restaurants and bars. The immediate benefit is, of course, that the music produced by a generative music system is copyright free and therefore no license fee is payable to either PRS or PPL. A generative music system would also enable more far-reaching control over the characteristics of the music played. Besides the ability to play a continually evolving stream of, say, classical or jazz music, data
mapping techniques could be employed to automate changes in both style and other characteristics of the music. For example, the system could be automatically set to play faster music at lunchtimes and in the evening in restaurants. Additionally, if a visual mapping device were used and detected that the restaurant was not full it could over rule the instruction to play faster music and play music at a more moderate tempo encouraging diners to remain longer at their tables so the restaurant didn’t empty too quickly and deter other customers from entering. Light sensors could also enable the system to offset the effects of low natural light on dull days by playing brighter summery music. Temperature or humidity sensors could also be used to produce similar changes enabling the music played to be fine tuned even further. By measuring the level of noise in a bar or restaurant the system could adjust the volume of the music so that it remains discreet and does not drown out conversation yet still offsets the effects of background noise. Additionally, by having sensors at entrances to shops the system could be programmed to play loud high energy music when the shop was full and more ambient relaxing music when the shop was empty. A generative music system with inputs from an array of sensors could tailor make music to suit any environment where music is normally used in the background.

Conclusion

“From now on there are three alternatives: live music, recorded music and generative music. Generative music enjoys some of the benefits of both its ancestors. Like live music, it is always different. Like recorded music, it is free of time-and-place limitations - you can hear it when you want and where you want” (Eno 1996)

This report set out to answer the question: “Is the future of music generative?” The answer to this question is no. Sadly, the image of redundant record company executives warming themselves around dustbin fires
under the M40 overpass lamenting about the “good old days” before “that generative music came along” is likely to remain a fantasy rather than a reality for the foreseeable future.

This does not mean to say that there is not a place for generative music within the current music industry or other cultural industries that use music. As Eno says there will be simply be three options for music in the future: live, recorded and generative music. Generative music will be increasingly adopted as people begin to understand why they need it and as they learn to adjust to listening it.

In fact, the process of adoption and adjustment has already begun through the commercial generative music applications that are currently available. Creation tools such as MadPlayer and Koan Pro allow users to create constantly evolving music and Tao’s iSS and Madwave’s Madmixer enable generative ringtones to be created for mobile devices such as phones and pocket PCs.

In films the development of an audiovisual generative engine by Jon Pettigrew, who was involved in the development of Koan, will raise the profile of generative music further. Microsoft’s DirectMusic Producer seems to satisfy the same characteristics in the music it creates that generative music could offer for interactive audio for games and therefore it is unlikely that a generative audio engine will be developed in this area for the moment.

The areas in which the applications of generative music have so far been unexplored are telephone “on hold” music services and music systems for public places such as retail environments, restaurants and bars. The benefits of developing a generative music system for these areas are that there are no license fees to pay to either PRS or PPL because pure gener-
ative music is free of copyright and also an autonomous generative music system would allow greater control over the characteristics of the music played. As awareness and acceptance of generative music through such systems increases generative music systems could then be developed for the domestic environment, as was the original intention of iHiFi, and also developed for the health sector where greater control over the characteristics of music could benefit those working in music therapy.

As the generative music systems are developed so will a new music business model to accommodate generative music and its production. The generative music composer will effectively become the ‘artist’ and the algorithm will become the ‘master recording’. Rather than receiving royalties through traditional royalties distribution channels such as PRS, MCPS, PPL and through the sales of physical and digital audio products, royalties will likely be accrued by the generative music composer each time the algorithm is selected by the user of a generative music system.

The future of music, then, may not be generative but there is a future for generative music.

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OTHER SOURCES


**MUSIC EXAMPLES**

Various examples of generative music can be found at:

Madplayer

http://www.madplayer.com/flash/productsMadDemo.asp

Supercollider

http://www.audiosynth.com/audio/

http://www.mushimushi.net/morpheus/

http://www.weatherplayer.com/pages/perform/samples.html

Koan Pro


Other

http://www.r4nd.org/rand_home.html
Paul Brown worked in the music industry in the UK for 15 years during which time he worked at PRS Ltd and then in music publishing looking after and promoting the publishing interests of various songwriters including David Bowie and Brian Eno. In the course of studying for his MA in Music Business Management at the University of Westminster in
London he became interested in generative music and in his final project investigated the possible effects that generative music might have on the music industry. Paul is hoping to continue his interests in generative music by exploring and developing the idea of the use of generative music systems as tools to assist both music therapists and patient carers in health settings through a research degree.

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