

To cite this chapter:

Mark Marrington, 'Paradigms of Music Software Interface Design and Musical Creativity', in R. Hepworth-Sawyer, J. Hodgson, J. L. Paterson and R. Toulson eds, *Innovation in Music II* (Shoreham-by-sea: Future Technology Press, 2016), pp. 52-63.

## **Paradigms of music software interface design and musical creativity**

Dr. Mark Marrington

York St John University, UK  
m.marrington@yorks.ac.uk

### **Abstract**

*Building on previous studies I have undertaken in the educational context, this paper offers observations arising from my ongoing research into attitudes and approaches towards music creation engendered by digital tools. The primary focus is on evaluating paradigms of software interface design (with a particular focus on the Digital Audio Workstation (DAW) and attendant third party plugins), ranging from the virtual environment scenario in which hardware tools are painstakingly modeled to imitate the real world of studio production, to interfaces which are rather more abstract in their visual structures, often encouraging the musician to think in terms low level computer process. The user's capacity to negotiate the constraints of the tool and assimilate its particular language is of importance in either case, whether engaging with visual metaphors for familiar technologies in terms of their real-world practical application or learning system-specific languages which constitute the building blocks of musical processes that are highly determined. The question concerning the extent of the software interface's propensity to shape aspects of musical detail, structure and style is at the heart of this discussion and is considered with reference to established theories of creativity (especially Csikszentmihalyi's 'systems' theory).*

### **1. Introduction**

During the last decade the Digital Audio Workstation (DAW) has established itself as the predominant technology for music creation and production. Indeed there is little contemporary popular music being produced today that has not at some point come into contact with a DAW, whether as a casual scratchpad for initial musical ideas or a powerful tool for the creation of fully produced and engineered recordings for distribution to the marketplace. In certain areas of popular music practice, such as songwriting, it has even supplanted the more traditional guitar and piano. This paper has two objectives. The first is to provide an overview of current perspectives on the nature of the DAW as a tool

for music creation with reference to particular frameworks that can assist us in characterizing its effect. The second is to offer ideas on how we might begin to appreciate the role that the DAW has played in re-configuring of the 'domain' of popular music practice over the last two decades. The word 'domain' here originates from Csikszentmihalyi's 'systems theory', which in recent years has been widely used to frame discussions of musical creativity in a number of contexts [1]. Summarised broadly, Csikszentmihalyi considers creativity relative to the particular environment within which the individual operates. He uses the term 'domain' to refer to an existing context of practice from which one assimilates patterns of creative approach (the rules of the game as it were) and 'field' to refer to the social factors (namely people and institutions) which determine those creative contributions that are most likely to be accepted into the domain. Participation within the domain necessitates being conversant with what Csikszentmihalyi calls its 'memes and systems of notation', in other words the specific symbol systems that one engages with in order to assimilate and communicate creative ideas. These are to varying degrees bound up with the nature of the medium employed, that is to say, the particular tools we use to create the music, whether pen and paper, the turntable or the piano. Where the DAW is concerned, its impact has been such that it has been responsible for engendering new ways of creating music – or in Csikszentmihalyi's terms, the DAW has introduced 'variations' into the domain which have been 'instrumental in revising and the enlarging' it.

## **2. An overview of current research into the DAW interface**

The DAW is primarily a visual environment represented graphically on a computer screen. Graphical interfaces have been a fundamental part of software design since the 1980s, and, are intended to enable the most intuitive and unencumbered means of accessing required functionality. A DAW's essential functionality, when reduced to its simplest terms, is to allow for the manipulation of two main forms of information, MIDI data and digital audio. The manner in which this takes place depends very much upon the design of the DAW interface in question - its visual structures and aesthetic connotations - which have particular consequences for creative decision-making and workflow.

It should be pointed out that a range of software platforms qualify as DAWs for the purposes of this discussion, each with its own paradigm for the representation of MIDI and audio information. By way of classifying these various forms of DAW and the various modes of interaction they engender, Duignan et al [2] have contributed a useful 'taxonomy of sequencer user-interfaces', informed by theories derived from the field of Human Computer Interaction (HCI). They posit four basic types – 'textual language music tools', 'music visual programming tools', 'sample and loop triggers' and 'linear sequencers'. The first two refer to interaction at the level of software coding whether in terms of textual or object-oriented programming languages. This would include programs such as MAX MSP and Pure Data for example, which bring the user closer to the computer-as-calculator. It is the third and fourth types which are closest to what most people understand to be DAW functionality, and significantly, bear the closest relationship to technologies and practices previously associated with the hardware domain. Sample and loop trigger models, for example, refer to earlier hardware such as the Roland drum machine or the MPC sampler (most obviously referenced in programs like Reason and Ableton Live) while linear sequencers refer to the multi-track studio environment (Logic, Cubase and Pro-Tools amongst others).

The design trend focused around the visual emulation of past technologies has been a predominant factor in DAW development since the release of Propellerhead's Rebirth in 1996. This phenomenon, which is sometimes referred to as skeuomorphism [3], has arguably flourished most in the area of third-party plugin design, as seen for example in the products developed by the Waves company, including emulations of the SSL desk, the Eddie Kramer Master Tape and the Abbey Road plugins collection. Duignan et al [4] have employed 'conceptual metaphor theory', as posited by Lakoff and Johnson (1980), to evaluate this aspect of DAW design, specifically in reference to Propellerhead's Reason and Ableton's Live, with a consideration of the extent to which the design objective is concerned with 'leveraging people's real world knowledge'. In discussing Reason, for example, they highlight the metaphors of the 'rack', the physical hardware 'device' and the 'cable'. A range of conventional metaphors common to a DAWs are found in Ableton Live, such as the mixer (in Session view), multi-track recorder (in Arrange view), and the oscilloscope (the waveform delay), although as the author's note, Live's approach to representation is on the whole more abstract than Reason's. With Live the authors also hit on a key point of interest relating to the conflation of contrasting approaches to dealing with musical material in a DAW reflected in the tension between the sample and loop trigger possibilities of Session view with the sequencer timeline approach suggested by the Arrange view.

While it is clear that graphical, rather than textual interfaces offer the most immediacy of interaction (in HCI terms, 'direct manipulation'), commentators have pointed out that metaphors for past technologies do not necessarily map effectively to the software domain. For example, there is a question as to the prudence of modelling more cumbersome aspects of real-world hardware (such as Reason's requiring the user to route multiple cables by hand), when it is within the power of software environments to offer more efficient and elegant solutions. Barlindhaug, however, has made the interesting point that the use of real-world metaphors in the design of DAW software is bound up with the appeal of specific tools in reference to the aesthetic characteristics of the music they were originally used to create [5]. The primary concern of a software package like Reason is thus not with user-efficiency, rather it is about tapping into the user's desire to commune with simulations of often inaccessible iconic technology of yesteryear. It follows from this that metaphors found in the DAW are essentially bound up with the notions users have about the particular kinds of music they wish to create with the software. On that basis we might, for example, generalize that Reason is meant to appeal to Hip Hop artists, Live is made for DJs, Pro-Tools is designed for the serious recording artist, Sibelius is meant to appeal to classical musicians etc. The medium in this sense essentially constitutes the creative process itself, in that one could only make *this* kind of music, using *this* kind of technology. It is doing more than simply functioning as a vehicle for the articulation of previously formulated musical ideas. Duignan et al [2] refer to this in terms of 'the underlying assumptions and structures that favours one form of musical structuring over all others.' (p. 3) Essentially we are dealing with the notion of technological determinism, which has frequently informed discussions of computer-based music-making. Brown [6], for example, echoing Marshall McLuhan's famous 'medium is the message' slogan, suggests that the computer,

'... like any other medium, effects the information (sound of music) that is stored in it or passes through it. The medium is not neutral; it has an effect on the music. When we are aware of this transforming nature of a medium, we can either compensate or utilize it. Only when we ignore it, or deny it, we risk the transformational change taking us by surprise or undermining our true intention.' (p. 9)

Mooney [7] has proposed a 'frameworks and affordances' model, for interrogating the effects of a given medium on the music it is used to create:

'A framework for music is any entity, construct, system or paradigm that contributes in some way to the composition or performance of music. [...] An affordance is something that a framework allows one to do.' (p. 144)

Of particular interest are Mooney's thoughts on the restrictions a given medium places on what is possible, or 'the relative ease or difficulty with which a given affordance can be actioned within a given framework.' (p. 145) To elaborate, frameworks afford a range of musical possibilities, which require varying degrees of skill to actualize depending on what is demanded in the use of the framework. To take a traditional musical instrument as an example, there are easy and difficult pieces that can be written for that instrument, all of which fall within the bounds that the framework permits. Pushed to its limits however, certain tasks become challenging and ultimately impossible to achieve within that framework – thus a solo flute will not allow for a faithful rendering of a Chopin piano piece. This raises the interesting question of the extent to which a particular medium can be bent to accommodate another affordance, an idea which has been explored by Zagorski-Thomas in his recent book, *The Musicology of Record Production* [9]. Here the discussion is couched in terms of 'ergonomics', with particular reference to the ways in which equipment designed for one particular kind of use becomes re-configured through user experimentation to another. Zagorski-Thomas uses the expressions 'centripetal forces of conformity' on the one hand to describe the user's adherence to what the technology was designed for, compared to 'centrifugal forces of rebellion' to indicate manipulation of the technology in the service of 'creative abuse'. The question of what the medium 'encourages' the user to do relative to what can be achieved in reality has also been a central premise of my own research which has focused on case studies of individual DAW users in an educational context [8]. The main conclusion that emerged from this investigation was that particular DAW frameworks do indeed modify the way in which users approach creating music. I noted, for example, the ways in which instrument-based approaches to composing were dramatically re-configured by the rationalized programming-style activities that were typically undertaken in DAW environments. On the other hand, it was also particularly revealing to observe the disregard that students often had for the implied conventions of a given DAW environment when unencumbered by preconceptions about what metaphors the DAW in question might have been designed to suggest. Take the Sibelius interface, for example. Its design is virtual manuscript paper, whose rules the classical musician follows, even though this effectively hides a MIDI sequencer. The user composes onto realistic looking pages of music (which can even be given a parchment like texture), inputting MIDI controller information which masquerades as score-specific performance instructions (indications for dynamics, articulation, expression etc). Armed with this awareness of what goes on under the hood, it becomes possible to push the tool further than its metaphor might permit, or in the words of Duignan et al [3], one can 'circumvent the metaphorical means of achieving tasks'. (p. 113)

### **DAW-specific literacies**

Returning to Csikszentmihalyi's aforementioned notion of 'memes and systems of notation' that one engages with in order to assimilate and communicate creative ideas, we can usefully begin to assemble an inventory of such elements where the DAW is concerned. The visual language of the typical arrange page, for example, might be regarded as a DAW-specific literacy which encourages particular attitudes to handling the

materials of a composition. Zagorski-Thomas has remarked on the strong effect of the visual 'block diagram' aspects of the sequencer-based DAW which 'would seem to encourage the user to think in terms of sound as an object rather than a stream' and that the 'choice of visuals, of what is represented, when and how, is a very powerful influence on the user' (pp. 134-5). I have similarly suggested [8] that the capacity to zoom out of the arrange window deconstructs the established notion of the composition as a design made apparent through unfolding in time and emphasizes the composition as object in visual space – in other words, the piece is essentially a block to be sculpted. Zagorski-Thomas also adds that '“cut and paste” methods of desktop systems have encouraged composers to work in a modular fashion' (pp. 147-8) as opposed, to say an organically evolving one. Mark Hansen [10] perhaps offers the most apt summation of these points in his comment that 'digital audio recording workstations ... confer the capacity to word process with sound.' (p. 121)

DAW-based artists themselves have also frequently remarked upon this particular visual aspect of the DAW. For example, in a 2003 *Sound on Sound* interview [11] discussing the making of his album, *Rounds*, Kieran Hebden (aka Four Tet), remarks that:

'People who make music on computers don't realise how powerful the visual element is. Whether you like it or not, your mind starts to think in terms of patterns, because it's a natural human way to do things, and you start seeing the way drums are lining up on the screen, and it becomes completely instinctive to line them up in a certain way'

adding the caution that 'It's important just to close your eyes and use your ears, and trust what's coming out of the speakers more than anything.

The following comment from the Dubstep artist, Burial, in a 2007 interview for *Wire* [12], implies a specific literacy built around the visual properties of waveforms:

'I've seen people using sequencers and I've tried hard to use them but it's blocks in different colours and I'm only used to just seeing the waves. I don't need to listen much to the drums because I know they look nice, like a fishbone, rigged up to be kind of skitty ...

More recently, the singer-songwriter James Blake, in a 2011 *Guardian* interview [13], made the following remarks on the importance of the DAW's visual structures (here referring to Logic Pro) in facilitating the creation of his music:

'I could record them and look at them, almost physically – graphically – and just chop up what I did like and I didn't like ... It didn't have to be all in one take, it could be something I designed from the ground up, visually. That process completely solved that problem for me.'

Duignan et al [2] have also drawn attention to the particular attitudes towards 'linearisation' engendered by DAWs – that is, the extent to which they encourage the organization of material on a timeline and how much flexibility there is for experimenting with alternative configurations. Mooney has commented (in reference to Steinberg's Cubase) that the timeline aspect of the DAW interface suggests to the user that the 'music should be built additively by appending one item after another until the desired duration is achieved', adding that the 'grid' encourages a 'default state of affairs' for the creation of 'rhythmical music in 4/4 time at 120 beats per minute.' (p. 147) Sequencer based linearisation of material certainly appears to encourage what Mark Spicer has

referred to as 'accumulative' forms of composition, in which elements of a composition are built up by the addition of smaller formal units until the piece appears as a completed jigsaw puzzle [14]. This is one aspect of the DAW that has become entrenched in writing approaches using it, which was why Ableton's move to Session View appeared to be such a game changer in the early 2000s.

Sample-loop techniques, as exemplified by Kieran Hebden's work, and numerous other DAW-based users, have, since the early 2000s, arguably become the most prevalent compositional approach engendered by the DAW. The naturalization of this way of thinking is perhaps most obviously evidenced by the fact that nearly all DAWs come pre-loaded with large libraries of musical phrases ready for incorporating into a track and there is a lucrative market for third party-materials (created by companies such as Loopmasters for example). This has particular implications for the question of what defines the domain of creativity in contemporary popular music because here the DAW itself is providing the essential building blocks of the composition for the user, which are often of such high quality that it is preferable to use them rather than invent from scratch. It is therefore not surprising that such loops should have ended up in released music, including some that have been globally successful- Rihanna's 'Umbrella', for example, which was famously built on a Garageband drum-loop [15]. Bennett in a recent discussion of the prevalence of computers in songwriting has even suggested that the proliferation of loop-based thinking as a result of the DAW has caused the technique to 'jump species' from computer-based genres back to band-based genres [16]. For Väkevä [17], sample-based practice is a form of 'digital artistry' specific to the DAW, which has transformed the idea of the original popular music artwork. Pre-conceived musical materials (including whole songs), used as the basis for musical compositions, he suggests are akin to the ready-made, Marcel DuChamp's term to describe mass-produced artifacts taken from the environment and re-contextualized as art. This has taken us a long way from the songwriter model of the earlier folk, pop and rock traditions, in which originality and authenticity of utterance were foregrounded. As well as radically altering approaches to building songs, the sampling aesthetic thus also reconfigures the domain from the perspective of the ethics of musical creation.

### **Traditions of popular music practice and the DAW**

One way to gain insight into the effects of the DAW on popular music practice is to look at situations in which clearly delineated modes of practice, such as songwriting, have come into contact with and been re-configured by computer-based approaches. The practice of songwriting was for much of the twentieth century largely driven by the guitar and piano, and these instruments determined both the musical content of the song and mode of its performance. The songwriter's engagement with technology beyond this point was when he/she took their 'rough demo' to a recording studio, where responsibility for the sonic elaboration of the music was usually passed to other personnel (until songwriters began to assume more control of the studio environment). In the era of the laptop, this practice has of course continued, with songwriters now employing the DAW in terms of its 'recording studio' metaphor – in other words, it is used as a virtual tape recorder to capture the completed song's performance for the purposes of arranging, mixing and mastering. The DAW has some obvious practical benefits over the traditional studio in this regard – the ability to recall multiple past states of creativity, the capacity to quickly comp together multiple takes into a single performance, the ability to build up complex arrangements using virtual instruments and so on – but it needs to be remembered these are simply enhancements of the ability undertake an established mode of practice.

It is the DAW's potential to impact musical creativity beyond such conventional notions of its use that are of greater interest here. Even in the context of employing the DAW as a production engine for a traditionally conceived song, the user's relationship with it will ultimately be determined by the attitude he/she takes towards using the tools the software offers. For example, while one has the option of using the DAW's various signal processing plugins in terms of their accepted practice, this requires a certain conversance with the functioning of the hardware equivalents upon which they are modelled. The vast majority of songwriters are not necessarily professionally trained engineers and therefore would not naturally engage with the technology in these terms - instead they may be more likely to resort to 'dabbling' with the tools. This 'incompetence' where such specialist skills are concerned is, as artists such as Brian Eno have illustrated, actually advantageous in discovering new creative possibilities. To this effect, it is interesting to note that the rhetoric of current marketing strategies for the DAW is concerned with making DAW tools appeal in terms of their alleged creative properties. Take, for example, the use of the word 'creative' in the following statement found in the online promotional literature for Logic Pro X [18]:

'Shift, shape, or completely warp the sound of any track using a wide variety of creative effects. Add texture using realistic reverbs that simulate hundreds of acoustic spaces. Build creative, complex delays or emulations of vintage tape echoes. Introduce harmonic saturation and sparkle with vintage tube modeling. Dial in fuzz and warmth with overdrive. Or capture that retro 8-bit arcade style with bit crushing. Use effects like phaser, chorus, flanger, and ring modulator to add subtle shimmer or glassy overtones. Create warm, pulsating sweeps or icy, morphing shifts using a variety of vintage and modern filter effects. You'll never run out of ways to mutate and twist your sounds.'

An exploratory approach towards employing the DAW's tools is in keeping with the aforementioned ideas of 'circumvention' and Zagorski-Thomas's notion of 'creative abuse'. Hugill [19] would even go so far as to suggest that this is the definition of the digital musician:

'A classical pianist giving a recital on a digital piano is not really a digital musician, nor is a composer using a notation software package to write a string quartet. These are musicians using digital tools to facilitate an outcome that is not conceived in digital terms. However, if that pianist or composer were to become intrigued by some possibility made available by the technology they are using, so much so that it starts to change the way they think about what they are doing, at that point they might start to move towards becoming a digital musician.' (p. 3)

There have been examples in recent popular music history of artists who have approached using computer technology in this manner of being 'intrigued by some possibility'. For example it is well documented that DAWs (specifically ProTools, Cubase and Logic) were used by Radiohead as a means of breaking out of the post-rock rut they found themselves in after *Ok Computer* in 1997. For the two albums which followed – *Kid A* and *Amnesiac* - the group purposefully avoided the paradigm of multi-track band recording and instead concentrated on using computers to sculpt new sounds from scratch (in Simon Reynolds' words, 'concocting sonic fictions'), which would then be the subject of a programming process. The move to computers was to an extent driven by the band's awareness of how certain ways of working with instruments had contributed to their prior, now unsatisfactory, musical trajectory. In the documentary, *Reflections on Kid-A* [20], Thom Yorke, for example, describes how he substituted the guitar for the piano

during the making of *Kid A*, as a means of breaking the former's stranglehold on his sound. Being a 'terrible' piano player was not a problem because 'the less you know about an instrument the more excited you get about it'. Computer-based methods, according to Yorke functioned as an antidote to the romanticism of 1990s post rock:

'... what I find interesting about taking on the electronic sort of things, like taking on programming, editing and that, sampling is that it stops you trying to emote. There's something I find incredibly exciting about just leaving something to run and stand there.'

The results of this electronic-music focused approach were particularly remarkable where the use of the voice was concerned. In an interview with Simon Reynolds [21], Yorke stated that he wanted to 'instrumentalise' his lead vocal, turning it via various forms of digital transformation (vocodering, autotuning etc) into a 'grammar of noises' - engendering a kind of reduction (or 'de-territorialization') of the voice which causes it to appear as sound itself.

What in effect took place in this instance was a re-configuring the rock band model as a result of its conflation with an electronic music aesthetic (derived predominantly from Yorke's interest in the Warp catalogue), which the DAW, then in its relative infancy, facilitated. While Radiohead present an interesting and prescient example of genre-transitioning via computers from one domain of practice to another, what is notable about the post-2000s generation who have developed their creative approach entirely within computer software is that the DAW constitutes an instrument in its own terms - in other words it is a starting point for the creative process rather than an endgame. Kieran Hebden, in the aforementioned *Sound on Sound* interview, states that:

'... the idea is very much that the computer's the instrument. If I wanted a guitar line or something, I'd never pick up a guitar and write a guitar melody to go on it. I might record some guitar into the computer, then start working on a track, and if I decide I need some guitar, I'd go to that recording, break it up into pieces, and then compose the melody using that sound. To get the sound I want and do what I want to do, it's all about using the computer as the instrument, and the most interesting stuff I've done has been all about that kind of idea.'

This is a significant observation which indicates that with the DAW we have essentially moved into a mode of simulation where references to past modes of practice are concerned. For Hebden it is the *effect* of a guitar performance that is achieved by using sampled guitar timbres as the material basis for more extensive ideas constructed entirely within the DAW itself. Ultimately the paradigms foregrounded by the software environment will determine how that particular material is manipulated and transformed. It is also worth remarking, incidentally, that Hebden is credited with single-handedly inventing Folktronica, a genre which relies heavily on sample-based techniques and owes its existence primarily to the advanced audio processing possibilities of the DAW [22].

## **Conclusion**

The DAW is perhaps best understood as a repository of virtual tools that refer, metaphorically or otherwise, to both the pre- and post-digital hardware traditions of music technology. It is an environment in which loop-trigger and sequencer paradigms, with their particular implications for organizing musical material, rub shoulders with sound design and sample editing tools, as well as virtual recreations of traditional musical instruments and notation systems. We thus have conflated in one location the potential



for a range of creative practices which hitherto might have remained separate from one another. For example, the user has available a number of tools which previously had been the exclusive province of electronic and computer-based music. The significant difference is that these tools are now available to anyone of any musical persuasion to be harnessed in any musical context desired. In addition we have the specific kinds of literacies that the DAW is lending to techniques of composition in that environment which are unique to the software architecture. Perhaps the most noticeable effect of the DAW's widespread use in the creation of contemporary music is that the boundaries between older instrument based approaches to creating music (traditional songwriting for example) and more recent methods derived from the electronic domain are beginning to be blurred, as illustrated for example by the fusion of Dubstep and singer-songwriter aesthetics in the recent work of James Blake. In other cases the DAW has spawned its own independent musical genres, built from the ground up within the DAW environment, as evidenced by the (now relatively long-in-the-tooth) examples of Folktronica and Dubstep, indicating that the perception of the DAW's capabilities has gone well beyond the recording studio metaphor which is still nonetheless used to market such software today. Perhaps the most telling indication that DAWs have established a niche as creative tools in their own right is the presence of extensive communities of practice associated with them – the vibrant user forums on websites for all the main DAWs, for example, and the proliferation of trade periodicals such as the UK's *Music Tech* magazine and *Computer Music*, which provide an easily accessible knowledge-base of current DAW-specific creative approaches. It remains to be seen whether DAW design will change radically in response to plethora of alternative creative approaches that are becoming associated with its users but the DAW's longevity as tool for music creation would appear to be increasingly bound up with the responsiveness of its designers to these developments.

## References

1. Csikszentmihalyi, M.: *Society, Culture, and Person: A Systems View of Creativity*. In: *The Systems Model of Creativity*. pp. 47–61. Springer Netherlands (2014).
2. Duignan, M., Duignan, M., Noble, J., Biddle, R.: *A Taxonomy of Sequencer User-Interfaces*. *Proceedings of the International Computer Music Conference*. 725–728 (2005).
3. Duignan, M., Noble, J., Barr, P., Biddle, R.: *Metaphors for Electronic Music Production in Reason and Live*. In: Masoodian, M., Jones, S., and Rogers, B. (eds.) *Computer Human Interaction*. pp. 111–120. Springer Berlin Heidelberg (2004).
4. Bell, A., Hein, E., Ratcliffe, J.: *Beyond Skeuomorphism: The Evolution of Music Production Software User Interface Metaphors*. *Journal on the Art of Record Production*. 9, (2015).
5. Barlindhaug, G.: *Analog Sound in the Age of Digital Tools: The Story of the Failure of digital Technology*. In: Skare, R., Windfeld Lund, N., and Vårheim, A. (eds.) *A Document (Re)turn. Contributions from a Research Field in Transition*. pp. 73–93. Peter Lang Publishing Group, Frankfurt am Main (2007).
6. Brown, A.R.: *Computers in music education: Amplifying musicality*. Routledge, New York (2007).

7. Mooney, J.: Frameworks and affordances: Understanding the tools of music-making. *Journal of Music, Technology and Education*. 3, 141–154 (2011).
8. Marrington, M.: Experiencing musical composition in the DAW: the software interface as mediator of the musical idea. *Journal on the Art of Record Production*. 5, (2011).
9. Zagorski-Thomas, S.: *The musicology of record production*. Cambridge University Press, Cambridge (2014).
10. Hansen, M.B.N.: Deforming Rock: Radiohead's Plunge into the Sonic Continuum. In: *The Music and Art of Radiohead*. pp. 118–38. Ashgate, Aldershot (2005).
11. Sound on Sound: Four Tet. Accessed May 2015 from <http://www.soundonsound.com/sos/jul03/articles/fourtet.asp>, (2003).
12. Mark Fisher: Burial: Unedited Transcript. Accessed May 2015 from [http://www.thewire.co.uk/in-writing/interviews/burial\\_unedited-transcript](http://www.thewire.co.uk/in-writing/interviews/burial_unedited-transcript), (2012).
13. Alex Needham: James Blake: "I didn't make this record for Chris Moyles, I'm in the dubstep scene." Accessed June 2015 from <http://www.theguardian.com/music/2011/jan/22/james-blake-dubstep-scene>.
14. Spicer, M.: (Ac)cumulative Form in Pop-Rock Music. *Twentieth-Century Music*. 1, 29–64 (2004).
15. Webb, A.: Is GarageBand top of the pops? Accessed June 2015 from <http://www.theguardian.com/technology/2007/oct/18/news.apple>.
16. Bennett, J.: Collaborative songwriting – the ontology of negotiated creativity in popular music studio practice. *Journal on the Art of Record Production*. 5, (2011).
17. Väkevä, L.: Garage band or GarageBand®? Remixing musical futures. *British Journal of Music Education*. 27, 59–70 (2010).
18. Apple (United Kingdom) - Logic Pro X - Plug-ins and Sounds, <https://www.apple.com/uk/logic-pro/plugins-and-sounds/>.
19. Hugill, A.: *The Digital Musician: Creating Music with Digital Technology*. Routledge, New York (2007).
20. Hodselmans, R.: *Reflections on Kid-A*. VPro (2000).
21. Reynolds, S.: Walking on Thin Ice. Accessed July 2015 from <http://www.followmearound.com/presscuttings.php?year=2001&cutting=131>, (2001).
22. Smyth, D.: Electrifying Folk: Folktronica, new folk, fuzzy folk - call it what you will. Laptops are replacing lutes to create a whole new sound. Accessed July 2015 from <http://www.standard.co.uk/goingout/music/futuristic-folk-7284965.html>, (2004).