Studies of Modern Music Production and the Methodical Uses of Musical Metadata

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Abstract

Digital technology has played a central role in revolutionising the ways in which recorded popular music is both produced and consumed. This radical transformation, coined as the "mp3-crisis" [117], has been both devastating in its impact, and has opened up opportunities for art, technology, and business. The rise of file sharing platforms and the accessibility of digital production tools undermined both the music business's model of distribution and models of music production leading to huge drops in revenue and a drastic reduction of the recording studio sector. Meanwhile, the emergence of digital marketplaces serving the supply chain are burgeoning, and the 'democratisation' of music-making digital tools has furthered the arts in allowing a broader range of people to engage in music-making.

Underlying developments in music technology have in recent years centred on the enrichment of musical metadata, which is emerging as a valuable resource driving novel and unique applications for consuming, discovering and interacting with music. In the music production domain, however, little is known about the role of musical metadata other than it has traditionally been treated as a by-product of the production process, having little or no value beyond that, and is largely discarded. Furthermore, music production processes have traditionally remained opaque to the kinds of inquiry that can contribute to understanding work practices and drive design thinking around novel and supportive applications of technology.

The thesis aims to address this problem space by addressing three main research questions: 1) How is music production organised in the "post-mp3-crisis" world? 2) What is the role of metadata in the social organisation of music production? 3) What are the implications of metadata's organisational production and use for the design of music production technologies? To address these questions, three empirical studies of music production are reported in this thesis that unpack and explicate much about the methodical purposing of metadata that are created and used in production processes.

The study findings contribute to addressing these research question as follows: 1) Demonstrating there are no longer 'standard' ways to model music-making activities and that understandings are better served by study at the level of work practices; 2) Detailing the organisational and coordinative role of metadata, which is elsewhere understated in its importance to music making processes. 3) Highlighting implications for design that suggest metadata has a role in extending functionality of music production technologies, which have been captured conceptually in academic publication, and demonstrated in engagement with design practitioners in the development of novel production tools.

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[1] But with fewer motivations for doing so.

Contents

ABSTRACT ..... **I**
ACKNOWLEDGEMENTS ..... **III**
CONTENTS ..... **V**
GLOSSARY ..... **VIII**
LIST OF PUBLICATIONS ..... **XVI**
CHAPTER 1 INTRODUCTION **1**

1.1 The Research Problem 1
1.2 Research Approach 2
1.3 Overview of Chapters 3
1.3.2 Some Notes on Terminology and Style 5
1.4 Contribution Statement 6

CHAPTER 2 RELATED WORK **7**

2.1 Digital Transformation of the Musical Landscape 7
2.1.1 Impact on Music Business Models 8
2.1.2 Impact on Music Production 11
2.1.3 Emerging Value Prospects for Musical Data 12
2.1.4 Summary 14
2.2 What Are Metadata? 15
2.2.1 A Survey of 'Music AND Metadata' in Design Literature 17
2.2.2 Current Understandings of Metadata in Music Production 24
2.2.3 Summary 27

CHAPTER 3 METHODOLOGY **29**

3.1 Ethnomethodology 29
3.1.1 The Missing What 30
3.1.2 Ethnomethodological Indifference 31
3.1.3 Reflexivity 31
3.1.4 Ethnomethodological Study (Apprehending the 'Missing Interactional What') 33
3.1.5 The Question of Interpretation 36
3.2 Ethnomethodology and Design 37
3.2.1 Origins of CSCW 38
3.2.2 Use of EM in Design: Making Work Visible 40
3.2.3 Building the Social into Design 42
3.2.4 EM Studies of Music Production. 47

CHAPTER 4 PRACTICALITIES OF THE STUDIES **49**

4.1 Rationale for the Studies 49
4.2 Issues in Participant Recruitment 50
4.3 The Participants 53
4.4 Ethics 55
4.5 Field Data Gathered 55
4.6 Duration of Fieldwork 56
4.7 The Settings 57

4.7.1 The Recording Studio 57
4.7.2 The Home Studio 58
4.7.3 The Project Studio 59

CHAPTER 5 A STUDY OF RECORDING STUDIO PRODUCTION 61

5.0 THE FINDINGS 63
5.1 SETUP 64
5.1.1 A) Situating Musicians, Instruments, and Equipment 65
5.1.2 B) Uses of Metadata in Situating Musicians, Instruments, and Equipment 68
5.1.3 A) Mic'ing Up 75
5.1.2 B) Uses of Metadata in Mic'ing up 81
5.1.3 Finishing Up 88
5.1.4 Summary of the Setup Stage 89
5.2 RECORDING 90
5.2.1 A) Preparing to Record 91
5.2.1 B) Uses of Metadata in Preparing to Record 92
5.2.2 A) Recording Songs 94
5.2.2 B) Uses of Metadata in Recording 96
5.2.3 Summary of the Recording Stage 102
5.3 OVERDUBBING 103
5.3.1 A) Reconfiguring the Setup 103
5.3.1 B) Uses of Metadata in Reconfiguring the Setup 105
5.3.2 A) Recording the Overdubs 107
5.3.2 B) Uses of Metadata in Recording Overdubs 108
5.3.3 Summary of the Overdubbing Stage 111
5.4 SUMMARY OF A STUDY OF RECORDING STUDIO PRODUCTION 111

CHAPTER 6 A STUDY OF HOME STUDIO PRODUCTION 114

6.0 THE FINDINGS 115
6.1 PREPARATION AND SETUP 116
6.1.1 A) Managing a Sound Library 116
6.1.1 B) Uses of Metadata in Preparing and Organising Production Resources 117
6.1.2 A) Initiating the Project 119
6.1.2 B) Uses of Metadata in Initiating the Project 120
6.1.3 Summary of Preparation and Setup 121
6.2 CREATING THE 'TUNE' 122
6.2.1 Building the Tune in Layers 122
6.2.2 Building the Tune in Sections 127
6.2.3 Uses of Metadata in Creating the Tune 129
6.2.4 Summary of Creating the 'Tune' 134
6.3 FINAL MIX-DOWN AND MASTERING 135
6.3.1 Testing the Rough Mix (The Car Test) 136
6.3.2 Preparing the Mix-Down 136
6.3.3 Doing the Mix-down 137
6.3.4 Mastering 137
6.3.5 Testing the Mastered Mix 137
6.3.6 Uses of Metadata in Final Mix-Down and Mastering 138
6.3.7 Summary of Final Mix-Down and Mastering 141

6.4 Summary of A Study of Home Studio Recording 142

CHAPTER 7 A STUDY OF PROJECT STUDIO PRODUCTION 144

7.1 The Findings 145
7.2 Process Planning 146
7.2.1 Determining Roles 146
7.2.2 The Artistic Brief 147
7.3 Handover 148
7.3.1 A) Evaluation 148
7.3.1 B) Uses of Metadata in Evaluation 151
7.3.2 A) Housekeeping 153
7.3.3 B) Uses of Metadata in Housekeeping 153
7.4 Summary of A Study of Project Studio Production 156

CHAPTER 8 DISCUSSION 158

8.1 The Dissolution of Standard Music Production Models 158
8.1.1 The 'Missing What' in Music Production Literature 159
8.1.2 The Influence of Technological Change on Music Production Models 161
8.1.3 Existing Models of Music Production 164
8.1.4 A Critical Comparison of Standard Models to the Findings 168
8.1.5 Summary 175
8.2 Understanding the Role of Metadata in Music Production 176
8.2.1 Furthering Understandings of the Role of Metadata in Music Production 178
8.2.2 Summary 183
8.3 Informing design 184
8.3.1 Metadata as a Resource in Music Production 184
8.3.2 Implications for Design 187
8.3.3 Toward DMOs (Digital/Dynamic Music Objects) 191
8.3.4 Limitations of the Studies and Future Work 193

CHAPTER 9 CONCLUSION 195
BIBLIOGRAPHY 199
APPENDIX CONSENT FORM AND ETHICS APPROVAL 223

Glossary

The studies in this thesis are of work practices at highly technical sites and as such contain a significant amount of technical vocabulary. Every effort has been made to explain terminology throughout as it appears in the text, nonetheless a glossary of common terms is provided for the reader below. The terms that require cross-referencing within the glossary are underlined, and the study/studies that each term features in is written in parenthesis as follows:

- (Rec. Study): A Study of Recording Studio Production
- (Proj. Study): A Study of Project Studio Production
- (Home Study): A Study of Home Studio Production

Acoustic screens (Rec. Study): Large portable vertical boards clad with materials that absorb acoustic energy that are positioned around instruments in a recording studio to minimise spill and help isolate a sound source that is being recorded via a microphone.

Audio sources (Rec. Study): Audio capture equipment includes microphone transducers, but also *DI Boxes* (Direct Input box). Microphones and DI boxes will be collectively referred to as *'audio sources'*, unless a specific instance requires otherwise.

Automation (Proj. Study): Data programmed to tracks used to change levels and other effect parameters over time.

Bouncing/Exporting (Home/Proj. Studies): Renders any real-time effects or edits applied to selected audio or MIDI in the edit window, which is done for two main reasons:

1. *To relieve the processing load on system*, individual clips are bounced, then replaced so that effects can be disabled, although the application of effects is irreversible
2. *To export whole, or parts of, the project* as either a complete song file, or as *stems*, which are individual song parts used in mixing and mastering processes.

Busses (All Studies): Virtual (DAW) or physical (recording console) audio routing used to aggregate audio multiple audio sources to one or two channels, usually via a send control. This is typically done to group or sub-mix multiple tracks, usually by musical part or instrument, to one set of controls. This enables unified sound level variations and treatments to be applied in order to cohere musical parts or instruments.

Channel (Rec. Study): An individual audio channel in a recording console used to route audio from the audio source to the DAW.

Digital Audio Workstation (DAW) (All Studies): The generic name for computer software used to make music and a central tool featured in the studies. DAW software is built with a complex range of functionality to support a variety of music production tasks including multi-track hard disk recording; electronic music composition; creating audio and effects; and editing and mixing audio. DAW software is commonly hosted on a PC with the following specification:

1. Sufficient hard disk space to store large amounts of uncompressed audio data.
2. An analogue/digital audio interface connected to studio hardware (for example monitor speakers).
3. Interfaces to other peripheral devices such as a Musical Instrument Digital Interface (MIDI) piano keyboard.

The DAW is typically designed with two main aspects to the central interface: the timeline and editing window and the mix window described in this glossary.

Direct Input Box (DI Box) (Rec. Study): A small device that converts the output signal from electronic instruments (electric guitars/keyboards) to a microphone signal, which is technically less problematic to record.

Digital Signal Processing (DSP) (Home/Proj. Studies): DAW software plug-ins that treat and process audio in real-time. In audio engineering terms, there are two main types of DSP:

1. Firstly *effects*, in which an audio signal is blended with a duplicate that has been processed, usually with a delay algorithm to create reverberation and echo effects.
2. Secondly *processors,* in which none of the original signal is fed through to the output after processing, to treat the sound with, for example, frequency equalisation (EQ) or automatic gain control (for example compressing or limiting).

Editing Audio and MIDI (Home/Proj. Studies): Editing functions are usually done in the DAW edit window. most common functions include: *cutting, copying, pasting, cropping, moving, fading in/out,* or *deleting.*

Fader (All studies): A physical or virtual linear control for varying audio volume of tracks and channels.

Foldback (Rec. Study): Real-time and/or pre-recorded audio fed to headphones worn by musicians, to support and synchronise their performances.

Frequency Analysers (Home/Proj. Studies): Analyse and give a real-time graphical representation of the mix of component frequencies of sound, to aid shaping and equalising the balance of frequency components of a musical part, or the overall sound mix.

Gain (Rec. Study): Cut or boost applied to and audio signal in both digital and analogue domains. This is not equivalent to levelling audio with faders.

Groups: See Busses.

I/O (Inputs and Outputs) (Rec. Study): Refers to the configuration of interconnections between studio equipment, and virtual routing of audio managed in DAW software.

Importing (DAW Function) (Home/Proj. Studies): Audio files for use in a composition can be dragged and dropped from a file explorer to the DAW edit window, or imported via a menu option. Audio files can be added to existing tracks on import, but DAWs usually create a new track labelled with the file name to contain the audio.

Live Room (Rec. Study): A room in the studio that is acoustically isolated from the control room.

Loudness Meters (Home/Proj. Studies): Give a real-time measurement the average volume (over several milliseconds) of sound mix within the available digital amplitude range.

Mid/Side Mix Analyser (Home Study): Enable the individual monitoring of sound components common to both L+R channels, known as the 'mid' heard in the middle of the stereo sound image; or sound components that are different in L+R channels, known as 'sides' that give a perceived width to the stereo image.

Mix (All Studies): A process of blending multiple audio sources. Mixing usually refers to the post-production process of editing and applying treatments, and audio processing and effects to multi-track audio, to produce a highly polished final product. A less refined process of mixing is also done at various points in the recording stages, to shape and evaluate sound.

Mix Window (DAW) (All studies): displays the configuration of audio channels, effects, and mixing controls, usually represented as a graphical emulation of an analogue mixing console (Figure 1). In this view during the music production process, tracks are typically: configured with virtual (MIDI controlled) instruments, or real-time audio effects and process; colour coded and ordered; or routed through a virtual 'bus' or physical output (known as sub-mixing or summing) to group audio by instrument type, or effect. Tracks and busses can be created in both edit and mix views using context menus options.



Figure 1 - The DAW mix window in ProTools

Mono/Stereo Mix Analyser (Home Study): Enables the mix to be switched from a stereo to mono, to assess if any sound is lost due to phase difference (see phase correlation meters).

Musical Instrument Digital Interface (MIDI) (Home Study): A protocol for transmitting digital note and control information between digital instruments. MIDI data can be recorded to a DAW track to be manipulated, edited and played back to real or Virtual Instruments to trigger sounds and control effect parameters.

Overdubbing (Rec. Study): A process of recording and layering sounds or musical parts in synchrony with pre-recorded music.

Patch Bay (Rec. Study): At the centre of the tie-line system is a patch bay that is configured to organise the default interconnections between equipment but allows new signal paths to be patched using cables as required.

Phase Correlation Meters (Home Study): Give a real-time measurement of the difference in signal phase between the left and right (L+R) stereo channels to avoid sounds cancelling out when L+R channels are mixed together on a mono sound system.

Piano Roll (Home Study): Piano roll editor (DAW feature) consists of grid divided horizontally by musical time divisions indicated numerically in bars and beats and vertically by pitch indicated by a virtual piano keyboard, which lights up keys in response to a MIDI input.

Project file (All Studies): Consolidation of audio files and other musical data into a project folder that can be transferred between processes and reused by compatible DAW software.

Plug-ins: (see Digital Signal Processing)

Re-amping (Rec. Study): Playing back pre-recorded audio, usually directly from an electric guitar, through different amplifiers and effects to re-engineer the sound and re-record the part.

Recording Console (Rec. Study): (also known as mixing console or desk) Used in recording studios for varying the volume and tone of audio and mix multi-channel audio. Audio connected to the channel inputs can come from live audio sources and routed to the DAW to be recorded, or pre-recorded audio outputted from the DAW.

Recording Real-Time Multi-Track Audio and MIDI (DAW function) (Rec./Home Studies): Can be done once tracks are created and configured. The DAW affords the capture of either full music ensemble performances, or individual performances layered over pre-recorded audio.

RedNet (Rec. Study): An interface for converting analogue audio plugged into portable rack mounted hardware that conveys multitrack audio over ethernet to the DAW, via control software installed on the host PC

Send Controls (All Studies): A feature of DAW tracks and recording console channels that sends audio via *busses* to a *group* channel or alternative output. Is used to create a *sum* (submix) of audio or route audio to and effect for example reverb.

Solo (All Studies): A function of mixing that enables users to select an audio source so that it can be heard in isolation from all other sources.

Spill (Rec. Study): Sounds picked up by microphones other than those they were intended to capture. For example, a microphone setup to capture a guitar amplifier may pick up traces of the drum kit nearby and so compromise multi-track audio separation.

Stems (Home Study): Layers of sound making up a musical parts are bounced to single (mono or stereo) tracks to prepare the musical parts for mixing. Consolidating the

layers of sound to fewer tracks frees processing power and simplifies the mixing process.

Sub-mix: See Busses.

Sum: See Busses.

Talkback (Rec. Study): Audio from talkback microphones situated in are a constituent component of foldback used create a complete communication loop between rooms.

Tie-lines (Rec. Study)**:** To connect audio sources in live rooms to recording equipment in the control room, professional studio use a system of tie lines, which are extensive cable runs built into the fabric of a studio, terminated in a jack socket mounted in wall boxes in the live rooms.

Timeline and Editing Window (DAW): Displays the composition and sequence of audio and MIDI clips graphically on two axes: the horizontal represents *time* measured in bars and beats, or in minutes and seconds; vertically, *tracks* (containers for layers of sound) (Figure 2). Audio and MIDI clips can typically be cut, copied, pasted, cropped, moved (on both axes), faded in/out, or deleted, in the process of recording, importing, sequencing and layering sounds into a song. Tracks and busses can be created in both edit and mix views using context menus options.

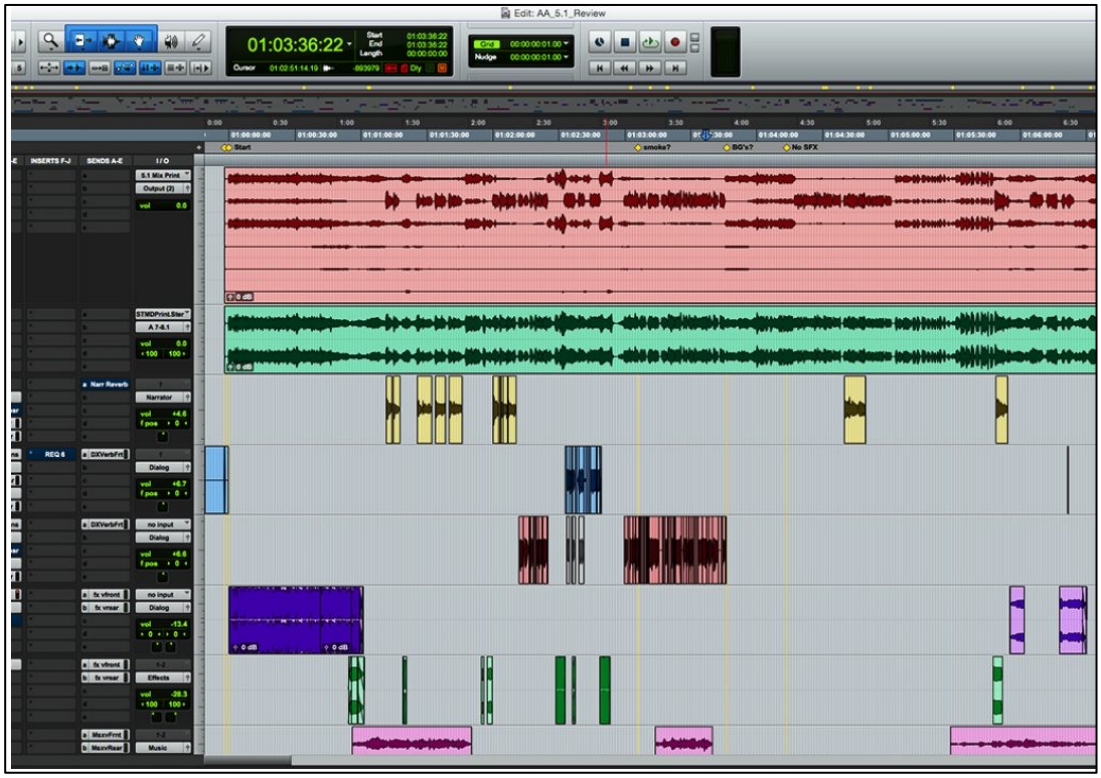


Figure 2 - The DAW Timeline and edit window in ProTools.

Track (DAW) (All Studies): A container for digital audio that can be configured to contain audio or MIDI. The digital equivalent of a track on analogue multi-track magnetic tape.

Track Labels (All Studies): Also known as a nameplate in which text can be entered manually in both edit and mix views, to label DAW tracks and organise audio. Otherwise the DAW applies labels to tracks automatically, which are usually derived from an imported audio file name; VI preset name; or system default such as 'audio 1' or 'bus 1'.

Virtual Instruments (Home/Proj. Studies): DAW plug-ins that emulate electronic and acoustic instruments. VI's are added to effect slots on MIDI tracks in the DAW so that sounds can be triggered and controlled in real-time typically using a MIDI piano keyboard.

Wallbox (Rec. Study): Various types of audio and data sockets mounted in wallboxes in recording studio live rooms, used to connect recording equipment between rooms via tie-lines.

Working Position (Rec. Study): The position in the control room of the recording studio that situates the recording engineer in an optimal listening position to perform detailed critical listening required for a range of recording activities; and in proximity to displays, peripheral devices and controls for operating the DAW and recording console respectively.

List of Publications

Publications

McGarry, G., Tolmie, P., Benford, S., Greenhalgh, C. and Chamberlain, A., 2017. 'They're all going out to something weird'. In: *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17*. [online] New York, New York, USA: ACM Press, pp.995–1008. Available at: <http://dl.acm.org/citation.cfm?doid=2998181.2998325>.

Poster presentations

McGarry, G., 2016. Understanding the Social Character of Metadata in Music Production. In: P. Kudumakis and M. Sandler, eds., *Proceedings of the DMRN+11 Digital Music Research Network Workshop*. [online] Queen Mary University of London, pp.1–29. Available at: http://qmro.qmul.ac.uk/xmlui/handle/123456789/19345

McGarry, G., 2017. The Social Character of Metadata in 'In the Box' Music Production. In: P. Kudumakis and M. Sadler, eds., *Proceedings of the DMRN+12: Digital Music Research Network Workshop*. [online] Queen Mary University of London. Available at: https://qmro.qmul.ac.uk/xmlui/handle/123456789/30583

Workshops

Apr - July 2016: The studies were presented at a series of three collaborative workshops in contribution to UK EPSRC project Fusing Semantic and Audio Technologies for Intelligent Music Production and Consumption (FAST) (EP/L019981/1) (see http://www.semanticaudio.ac.uk/blog/ethnographic-studies-of-studio-based-music-production/)

Invited talks

Oct 2016: Ethnographic Studies of Music Production: a research project example for Audio & Music Technology undergraduates, Confetti Institute of Creative Technologies.

TBC: School of Arts Research seminar, University of Derby.

Chapter 1
Introduction

The rise of digital technology has radically reconfigured the musical landscape, disrupting and reshaping the ways music is both produced and consumed. This radical reconfiguration has been labelled the "mp3 crisis" [117], in reference to the global rise of illegal file sharing in the late 1990's to early 2000's, through which a plethora of new possibilities have opened in its wake. In the post-mp3-crisis world, digital technology is being leveraged to develop new delivery platforms for music consumption and 'democratise' music production [140]. The overall share of music industry revenue from digital download and streaming services, via iTunes or Spotify for example, has been steadily increasing over recent years and at the outset of this thesis, matched those of physical format sales [122] but has now surpassed them considerably [122,123]. In the domain of music production, the ease of accessibility to these digital marketplaces coupled with affordable music production tools, such as Digital Audio Workstation (DAW) technology, has enabled a broader range of people to engage in producing and distributing music, often independently from major record labels [116]. Digital technology continues to open new possibilities for music production and consumption, from creative and performance activities with new musical interfaces; recording and production with innovative digital audio software; to new ways of distributing and consuming music. At the heart of such digital technologies, metadata has emerged as a driving factor in the design of diverse and novel forms of commercial music consumption, however little is known about the role of metadata in music production and the potential value prospects for its exploitation in design.

1.1 THE RESEARCH PROBLEM

My thesis focuses on exploring new possibilities that may be enabled by exploiting metadata to develop new forms of value in music production and consumption. Uniquely, the focus is on the social character of metadata in modern music production to understand its role in coordinating and accomplishing production processes. This in turn opens up the social life of music production (for example, the actors involved in making music, the activities and collaborations they engage in, the resources they exploit, how music is crafted in practice) to drive design thinking around new value propositions exploiting metadata. This will entail close inspection of production processes that are, at the current time, poorly understand and opaque. As New York Times resident music critic Ben Ratliff puts it:

> "The feelings of disorientation, of not knowing what process makes what sound, of not really understanding what "producers" do, are question marks now built into our hearing." [178].

There is then, a need to not only hear that question marks exist, but to actively explore them and so in this thesis I propose three research questions to address:

How is music production organised in the "post-mp3-crisis" world?

As DAW technology has opened up music production possibilities, so the traditional recording studio sector has declined due to the high-cost and requirement for specialist skills to facilitate the rigorous production methods and processes. In contrast, the DAW offers flexible, low-cost production but remains largely unstudied in it real-world use. My research then aims to examine the transformation and emergence of modern music-making practice.

What is the role of metadata in the social organisation of music production?

Concepts of metadata are broad, but for brevity can be summarised as 'data about data' i.e. descriptive data about the products of production, in this case musical objects[71]; and the organisation of that data, both formal and informal, invoked for the accomplishment of work [226]. My research aims to identify metadata created in the course of real-world, real-time music-making and how human actors exploited these.

What are the implications of metadata's organisational production and use for the design of music production technologies?

My research also aims to identify implications for design that open up possibilities to exploit and create value from production metadata. This informing of design includes collaborative work with developers on the EPSRC FAST project [74], but also the identification of other relevant areas of technical development, and contributions to knowledge.

1.2 RESEARCH APPROACH

To address the research questions above, I carried out three empirical studies of modern music production consisting of detailed 'design ethnographies', in which I employed fieldwork methods to closely examine the practical interactional and collaborative accomplishment of musical processes and the production and use of metadata within them. Employing this methodology for social inquiry originates from the field of HCI (Human-Computer Interaction) and is highly appropriate to address the research problem, given the opacity of production processes [211] and the researcher's ability to 'get inside' the work of a setting to develop first-hand knowledge of its accomplishment and organisation [47,176]. This approach is also in response to the dearth of observational studies in the area of music production. Most insights into this complex world of work are provided by music practitioner's literature which are replete with theoretical glosses on the work, but are insufficient on their

own to be useful to systems design [202,206]. Even in the field of ethnomusicology, a discipline that actively studies 'music-making', the production of recorded music is actively eschewed as a topic for research and further still subjects its observations to the kinds theoretical and sociological perspectives that consistently miss the orderliness of ordinary action. My studies then, involve in-depth fieldwork of music-making processes and subsequent analysis of the 'ethno-methods' that parties to the work use in concerting and coordinating their situated activities, in order to glean some concrete insights that contribute knowledge and inform systems design.

1.3 OVERVIEW OF CHAPTERS

Chapter 1 – Introduction

Introduces the problem space and gives an abstract overview of the research work and results included in the thesis.

Chapter 2 - Related Work

A review of the literature related to the thesis, beginning with an examination of the "post-mp3-crisis" contemporary musical landscape, including the burgeoning digital music markets, and the rise of democratised music-making enabled by digital music technology. This is followed with a survey of literature to define and identify trends in musical metadata research across the entire value-chain, which in turn reveals a scarcity of empirical studies of music production.

Chapter 3 - Methodology

Discusses the ethnomethodologically informed ethnographic methods, or 'design ethnography' employed in this research to do observational studies of music-making activities and present the findings so that they are tractable to design. This methodology is rooted in EM (ethnomethodology), which is a respecification of social inquiry that aims to, in short, examine people's contingent assemblages of locally adequate methods. In turn EM explicates the social character of organisational and work practices in the production of work, as they are recognised and made ordinary to members of a setting.

Chapter 4 – Practicalities of the Studies

Provides a preface to the studies and discusses the practicalities of accomplishing first-hand studies of music production; an area which is renowned as being difficult to access for the purposes of academic inquiry. Acquiring access to study sites for this thesis was, of course, not without its challenges and these are detailed here for future reference, as is the approach to doing the field work.

Chapter 5 – A Study of Recording Studio Production

Presents a study of recording real-time band performances in a recording studio; an archetypal environment associated with traditional music production installed with sound proofed rooms, and high specification multi-track recording equipment. The study provides insight into the character of metadata created and used in the process and its role in documenting the process and coordinating resources and actors in a range of production activities.

Chapter 6 - A Study of Home Studio Production

Presents a study of several of music-making activities in a music producer's home studio. The findings demonstrate the iterative character of processes used to bring compositions toward completion and the role that metadata plays in different activities. The studies again demonstrate troubles in that metadata purposed for specific tasks, eventually become subject to new requirements and so an overhead is created in reconstituting the metadata work across processes. This is not necessarily problematic at all points in the process but provides insight into opportunities for design to exploit and better trace data as it propagates through the process.

Chapter 7 - A Study of Project Studio Production

Presents a study of the work of a professional producer in a small project studio, undertaking a 'client-mix' of a collaborating artist's demo songs in preparation for developing the songs further in future production process. The findings indicate a radical re-specification of models of production in what the producer called 'a recursive process' of iteratively developing songs. This relies on the exchange of musical data between processes but highlights significant troubles in doing so.

Chapter 8 - Discussion

Discusses three main contributions in the findings: *firstly,* that standard models of production have dissolved given the flexibility and broad range of modern music production activities that the DAW enables; *secondly,* the empirical explication of understandings surrounding the role of metadata in music production, not as a technical concept but as a resource for annotation practices, organising musical elements, and coordinating prospective processes and in the in-situ accomplishment of music-making activities; *thirdly,* the impact on design thinking and value prospects resulting from the findings, including a contribution toward metadata-driven extension of DAW functionality, the specification of Digital Music Objects (DMOs) other opportunities for design that the research presents.

Chapter 9 – Conclusion

Provides a summary discussion of the research work done, the results, and the contribution to knowledge provided by the thesis.

1.3.2 Some Notes on Terminology and Style

The presentation of this thesis is intended to emulate the formatting and layout of HCI literature. In each chapter I provide a short abstract followed by an introductory section that lays out the relevant background and context to the main body of the text, which is in turn followed by a summary of the topics discussed. Within the main body of text, I break down the discussion using what I intend to be a rational ordering of topics under headings and sub-headings. Throughout the thesis I have endeavoured to write each chapter such that it may be visited on its own and with minimal the need for cross-referencing terminologies and jargon relating to music technologies. Nonetheless, the subject matter of the studies is a highly technical domain and so it has been necessary to provide a glossary of terms that appear in the studies (pp viii).

A further note on style, I substitute the word ‘creation’ in reference to the production of metadata, in order to disambiguate the use of the word ‘production’. In the design ethnography domain, the word ‘production’ is applied generally to refer to, for example the ‘production of work’ or ‘production of resources’ etc. In music however, ‘production’ is specific to recorded ‘music-making’, which is term I use interchangeably, and so reserve the use of ‘production’ throughout for this purpose. In a final note, with the exception of this introduction and the conclusion, the main body of the work is written in the third person and any reference to ‘we’ refers to the traditional sense of me, the author, and you, the reader, as we navigate the discourse of my thesis. This differs from the current trend in academic writing in which ‘we’ and ‘our’ tends to refer to co-authors of a text but has on occasion been adopted in this sense by sole authors.

1.4 CONTRIBUTION STATEMENT

My thesis makes original contributions to understanding of how music is made in practice and the novel value propositions that may be derived from understanding the social role of metadata in the making of music. The following summarises the ways in which my research has addressed the research questions set out in this thesis:

Addressing the Research Questions

How is music production organised in the "post-mp3-crisis" world?

The organisation of music production is examined in three differing scenarios that demonstrate a diversity of modern music production processes. This brings in to question the validity of standard process models as a suitable means for representing the work of music-making and the roles of the actors involved and proposes an alternative approach to furthering understandings at the level of work practices through further observational study.

What is the role of metadata in the social organisation of music production?

The social character and role of metadata is considered in the studies and treats the findings separately from technical topics in order to explicate metadata as a resource in music production. The role of metadata is to variously document the process; provide for flows of work; and coordinate work in situ. Metadata is also shown to be multi-modal phenomenon, and, for other reasons, the source of processual challenges, both of which are taken in up addressing the final research question.

What are the implications of metadata's organisational production and use for the design of music production technologies?

The implications for design are considered in relation to the findings resulting in four main proposals based on observations from the studies: *Firstly*, that the functionality of the DAW should be extended to better support the handover of musical data; *secondly*, that the DAW should non-destructively track and preserve the transformation of musical resources and provide end-users with the option to 'roll-back' parts of the process more intelligently; *thirdly* that designing toward capturing and aggregating multi-modal data created in the course of music production should be given serious consideration; and *finally* that all of the above applications can potentially contribute to, and be realised in the existing concept of the DMO, which proposes to provide solutions toward the computational generation of metadata for improved ways of exchanging and reusing musical data.

Chapter 2
Related Work

In this chapter the literature relating to topics in the thesis are reviewed in two parts. In part one, we explore literature in support of the motivations for this thesis: the "post-mp3-crisis" transformation of the musical landscape influenced by the introduction of digital technologies throughout the music value chain. Within this problem space, we also explore the emergence of metadata as a resource driving novel application in the consumption of music. In part two, a survey of trends in the literature surrounding musical metadata reveal that there is a knowledge gap regarding real-world studies of metadata creation and use in music production.

2.1 DIGITAL TRANSFORMATION OF THE MUSICAL LANDSCAPE

The motivations for this thesis are based on the impact that digital technology has had on the business of producing and marketing recorded music, disrupting the entire value chain and radically reshaping the contemporary musical landscape. The music industry does not stand alone in this regard. The affordances of the internet have been the central factor in the decline or transformation of several industries for example: News publication has risen online while printed media has declined; internet banking has led to closures of high street branches; and on-demand TV and movie services have led to the decline of DVD rentals and sales. Digital technology has not only revolutionised the delivery of products and services, but the ways in which industry itself is accomplished.

The disruption that digital technology has wrought on the music industry has possibly been one of the most radical and well known, causing a broad set of largely misunderstood issues and a raft of unclaimed opportunities. This phenomenon is of interest in the field of human geography in which Hracs [117], Leyshon et al [140,141] and Watson [219] chronicle the challenging transition to the contemporary music landscape and the impact of the "mp3 crisis" on the music business and the production of music. These two key areas, the impact on music business; and the impact on music production, are explored next in order to provide the context for understanding the contemporary musical landscape.

2.1.1 Impact on Music Business Models

Leyshon et al [141] identify the music industry's slow response to the mp3 crisis as the main catalyst for the transformation of the musical landscape, as this eventually led to record companies effectively losing control over a business model that was traditionally driven by distribution and sales of physical media. In the late 90's, the increased affordability of digital audio software capable of ripping music CD data to a shareable data compressed mp3 file format, combined with the rise of file sharing platforms dealt a devastating blow to music industry revenues. The industry's attempts to redress the problem through legal means were largely ineffectual and, in the meantime, the scale and momentum of illegal digital distribution grew far beyond the industry's control. This crisis marked a decline in distribution and sales of physical media which had been the industry's main revenue model for nearly a century. The emergence of legal digital distribution platforms and digital copyright protection transformed the industry's fortunes somewhat, however the industry's control over these platforms are realistically limited and do not completely eliminate the issue of illegal copying and sharing.

The subsequent decline in business led to the artistry suffering as major labels became risk averse to paying out large cash advances to developing new artists, as had been the practice in times of the industry's boom, and instead adopting the now common practice of contracting ready developed and/or commercially proven artists. This industry practice transferred financial risks to independent labels or emerging artists themselves [168:145–150] leading to the need for new music artists to diversify their skills beyond their creative output to the broader range of business management activities. For example, in Hoare et al's [116] studies of amateur music makers use innovative methods for engaging audiences through social media and the distribution of unique and novel music products, to develop their artistry and nurture commercial interest.

The example above, however, does not represent the extent of new business models available to modern music industry practitioners, for example David Byrne identifies six contemporary models for the control and sharing of music distribution revenues between artists and record companies[2]. Represented in Figure 3, these six models sit along a sliding scale between the traditional '360° deal' in which record companies control all aspects of a contracted artists music production and share of revenues; to 'self-distribution' in which the artist controls all aspects of music production and distribution, bypassing the record company altogether (see [33:7] for further reading).

[2] David Byrne is famously of the band Talking Heads, a solo musician, and independent music maker.

This transformation of music business practices, as recognised in the literature [33,34,117] and studied in part [116,159], marks a significant shift in power away from major record companies.

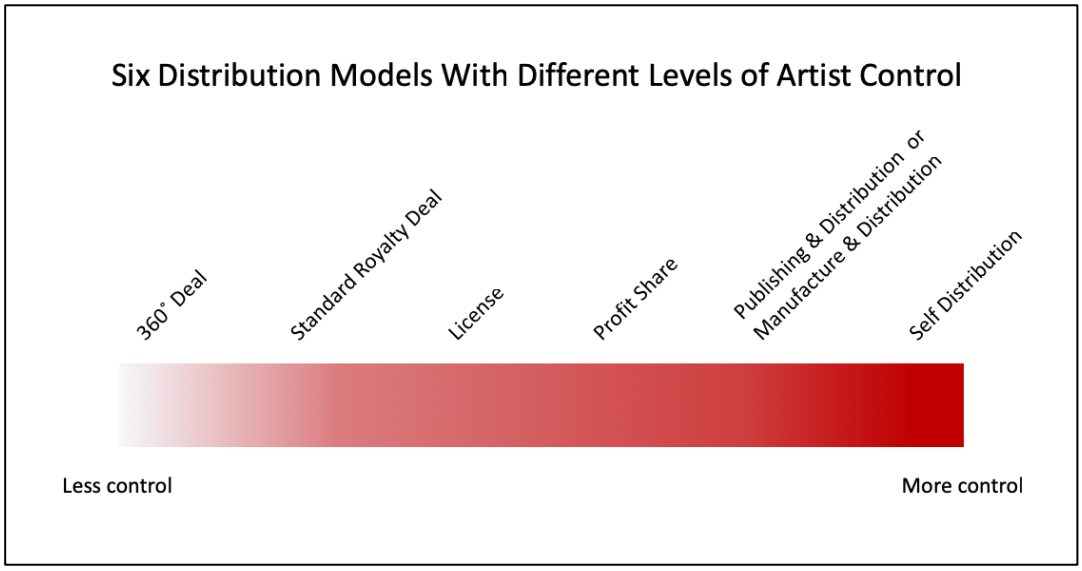


Figure 3 - Six Distribution Models reproduced from [33:220]

This power shift is also being played out in burgeoning digital marketplaces, which deliver digital format music via download or streaming applications that retain proprietary controls over music content, and through music licenced to other digital channels for example film, television, advertising and mobile phone ringtones. These services are a boon to consumers and are steadily gaining popularity as global revenues from digital sources equalled physical formats for the first time in 2014 and surpassed them in 2017[3]. However, revenues returned to artists, in particular independent artists, are reported as being meagre due to opaque and inconsistent business practices that seemingly favour major record companies. Cited among unfair practices are, for example, unnecessary manufacture and breakage deductions normally applicable to physical format distribution deals; and a focus on the profitable release of back-catalogues, which incur no production costs for the record company in contrast to the investment risk of supporting new artists [34]. The advancement of new music artistry and technological innovation currently remains at an impasse in the main stream music industry; as Hracs [117] states "homogenisation" of music is still prevalent despite product diversity being the key to music retail success.

[3] Digital accounted for 46% of $14.2bn in 2014 and 54% of $17.3bn in 2017 [122,123]

Music artists are now in a business climate in which their recorded music is virtually given away and incomes are being generated from alternative revenue streams including for example monetization through YouTube; innovative and novel ‘fan’ products, such as custom made cassette tapes [116]; sponsorship from advertisers ; and licensing of music synchronised to commercial film and TV [122,123]. There is also an increased emphasis on live performance, which has traditionally been a ‘loss leader’ to promote lucrative sales of physical media but is now an essential component of a music artist’s revenue. In response to this new economic climate, artists such as Zoe Keating and Imogen Heap are leading the calls for more transparency and equity for artists who push new music through digital platforms [67,68] and for music industry uptake of new technologies such as blockchain, a system for recording and securely encrypting transactions of digital objects, to manage proprietary information and bring about fairer revenue distribution [108]. The mainstream industry is now joining the call to address the ‘value gap’ amongst digital channels, citing YouTube as an example of poorly enforced rights management resulting in low revenue, but is instead taking a differing approach through legislative means [123:26–29]. Both pressure from legal and business perspectives are indicative of a need for digital solutions that better reflect the diversity of the musical landscape and that connect the music value chain, not only through the distribution of music, but also in the production of music which has also been transformed through digital technology.



Figure 4 - Acclaimed electronic music artist Four Tet, tweets a picture of the DAW used in the production of his 2017 album New Energy.

2.1.2 Impact on Music Production

In tandem with the digital revolution in music consumption, DAW is now a ubiquitous tool that has transformed music production and opened up new possibilities for music creation beyond the recording studio. Preceding the DAW, *the* prevailing method of music production centred almost exclusively on professional recording studios and their associated rich tradition of methods and processes [29,111,163,164]. All this changed in the 1990's however, as the DAW enabled novel, inexpensive [33:213], and distributed [219:6] methods of production to gain traction (also see Figure 4 for an example).

This transformation compounded the mp3 crisis power shift further, as musicians eschewed the indulgent expense of commercial recording studios and took on the production of their own music using a new generation of affordable recording technologies. Recording studios no longer had a monopoly over music production resulting in many closures within traditionally geographically concentrated centres of music production, for example New York, London, and Los Angeles [219] [140]. David Byrne gives some first-hand insight into this transition.

> "With the advent of relatively cheap recording equipment with studio-quality sound, not only would anybody with two turntables and a microphone be making records, but everyone else would, too, in an incredible variety of styles and approaches, everywhere and anywhere. Musicians didn't have to migrate to the big cities with their expensive studios anymore… …As the costs or recording dropped precipitously, emerging musicians all over the world were increasingly on an equal footing with well-funded Western pop/alt/urban musicians. Amateur musicians have always been equal as far as playing and writing go, but now more and more of them will be taken seriously – the quality of the recordings will be virtually indistinguishable." [33:175–176]

Despite their decline however, recording studios still have a role in meeting requirements of certain musical projects and so small/medium project studios are now prevalent in this sector [209] and are often used as part of a broader process across several production sites that include home studios [33:5]. This transition has impacted the role of recording professionals in several economic and practical ways [219:III], for example the role of engineer (working the recording equipment) and producer (attending to artistic direction) are often rolled into one [219:30].

Studio professionals are also increasingly taking to freelancing and entrepreneurship, as fewer commercial studios provided secure employment, resulting in a remarkable impact on the music production landscape as professional practices are beginning to be publicly disseminated and monetised through digital channels. This is a significant departure from this traditionally secretive world in which sound engineers would trade on their reputation for achieving a trademark sound, often within a particular studio setting [169:94]. David Pensado, Grammy award winning mixing engineer, has led the way in this sphere with publishing innovative web content surrounding contemporary music production that features highly successful music business

professionals[4]. Over 193,000 subscribed viewers have viewed 'Pensado's Place' content over 16 million times and the 'Mix With the Masters' YouTube channel with similar content has over 92,000 subscribers who have viewed content over 4 million times[5]. This transformation in professional practice against the backdrop of a radically altered industry indicates the extent of democratisation in music production and the novel ways in which music professionals are leveraging technology to exploit new value prospects from their expertise.

2.1.3 Emerging Value Prospects for Musical Data

Musical metadata, i.e., data implicated in the production of a musical object (for example, a song), has traditionally been treated as a by-product of the production process, having little or no value beyond that, and is largely discarded. However, in the post-mp3-crisis world, metadata is beginning to be leveraged to drive novel applications and services. For example, academic research has explored the use of metadata to extract audio features from within the music production workflow, such as melody, style, timbre, instrumentation, and song structure, to enrich the metadata surrounding the process [36]. The metadata generated has further applications in: music transcription [20], for music learning [217]; instrument identification [129] and other semantic audio terms (tone, timbre, style) [132] for music discovery services; automated audio editing [79,80,104] and mixing tasks [107] for intelligent music production. Textual information has also been captured for application in intelligent music production [151,224]; and tracking production histories [11–13] and the production process [81,225] to preserve valuable provenance information, not only in terms of data lineage, but also in terms of documenting production processes to support project management, and to synthesize processual metadata to appeal to consumer interest.

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[4] "Pensado's Place - Learn how to produce, record, mix, and master music and audio." [Online]. Available: http://www.pensadosplace.tv/. [Accessed: 30-Apr-2018].

[5] "Mix With The Masters - YouTube - YouTube. [Online]. Available: https://www.youtube.com/user/MixWithTheMASTERS/featured. [Accessed: 30-Apr-2018].

"Pensado's Place – YouTube." [Online]. Available: https://www.youtube.com/user/PensadosPlace/about. [Accessed: 30-Apr-2018].

Metadata is also beginning to be exploited commercially, for example:

- *BBC My Tracks* (formerly Playlister) [17] allows users listening to radio stations through a web player to add tracks being played that they like to a personal playlist, receive music recommendations based on the saved tracks, and export playlists to Spotify, iTunes, Deezer and YouTube so that the full tracks can be listened to. The service exploits metadata in the *MusicBrainz* website [205], which is an open music information source that contains production and editorial information about commercially released recorded music.
- *Discogs* [56] is a website with a rich feature set aimed at physical format music collectors who want to document their collections, create 'wantlists', find new music, and trade music. The site uses metadata extensively to present detailed production information in each record release's profile and provide links to related releases and discography information about the musicians, production personnel, studios, and record companies, amongst other information.
- *Who Sampled* [223] also offers music discovery opportunities to users, but uniquely focusses on music that uses samples of other music in its production, or has been sampled, covered or remixed. Users can browse the musicology connections, listen to tracks and purchase the ones that they like from iTunes, Amazon, and eBay. The metadata that drives the application is crowdsourced from contributors in the website's community and moderated by a resident team.

The Who Sampled example in particular provides a pointer toward consumer interest in exploring how records are pieced together that goes beyond editorial information. This aspect of music consumption, traditionally catered for in physical album liner notes [23,43,51] is often lamented as a missing part of the digital listening experience, however attempts to address this apparent shortfall in music consumption value with "digital liner notes" have been problematic.

In 2016 the music industry's multimillion dollar Global Rights Database project to centralise intellectual property rights information failed to meet its aims [72]; this repository had been earmarked since 2013 as the information source for digital marketplaces to begin publishing digital liner notes [194]. In the ensuing vacuum, online music platforms such as iTunes and Tidal introduced proprietary digital liner notes [190]; artist services such as TuneCore offer to produce digital liner notes to add value to music releases [44]; and artists have innovated with publishing digital artwork to accompany record releases [87]. Nonetheless, at present digital liner notes are far from becoming the norm within the digital music marketplace and Ann-Derrick Gaillot (Staff Writer at culture website The Outline) cites Steve Jones's (Professor of Communications at University of Illinois at Chicago) to critique their efficacy in the face of contemporary music consumption trends:

> "…the absence of digital booklets can be attributed to two things. First, given all of the different platforms on which people consume digital music, juggling the different template standards for each can be cumbersome. Second, people aren't looking at digital booklets because we aren't listening to albums like we used to. "You don't bring it home in a container and listen to it and look at the sleeve, read the liner notes, et cetera," said Jones. "You buy your music or stream it instantaneously, usually while you're doing something else. The space in which one would have looked at the visuals has gone by the wayside." …" [87]

As digital liner notes appear to inadequately add value to music, the problem space is still open to innovation, for example the TunesMap application for smart TV aims to allow music listeners to interact with and explore media associated with music played back from their personal collections [198].

2.1.4 Summary

Beyond the mp3 crisis and into the present musical landscape, digital technologies continue to open new possibilities throughout the music value chain including music creation and performance with new musical interfaces; record production with innovative software; and novel listening experiences. There now exists a richness of creative and consumer experiences emerging in the musical landscape that is leveraged through musical data, however novel value prospects from data surrounding music production are seemingly lagging in terms of research and development. Information about how records are pieced together, the musicians and instrumentation and content of music such as lyrics that have a demonstrable value to consumers that has been lost in the transition from physical media to digital consumption. Furthermore, in the democratised world of music production these data arguably have an increased value as consumers turned producers seek to inform their own music-making practices. Within the literature then, three distinct areas of interest for technological design have been identified:

Firstly, opportunities for modern music business to open up the music marketplace and enable new and innovative approaches to issues of ownership and control, production and distribution of music, and artistic and commercial innovation. There are also opportunities for the design of digital technologies that tie together the value chain in better ways, particularly to support independent music makers who are required to diversify their skills in order to compete in the market.

Secondly, digital technology is shown to have respecified music production, opening up a broad range of inexpensive music-making possibilities and transforming the role of music production and the actors involved. This provides opportunities for design to better support new methods of music production and to capture and exploit value prospects of processual data, for example exchange of ideas and methods within a community of practice.

Thirdly, metadata is emerging as a new resource for driving novel musical experiences that allow consumers to interact with music beyond the editorial data surrounding, artist, album and genre and into new experiences of musical discovery of both features of recorded sound itself and linked information. In the production domain however, novel technologies are yet to emerge despite the development of underlying technologies such as the studio ontology framework for describing music production spanning workflows, events, timelines, device interconnectivity, recording, mixing, effects and editing [81]. The value from enriching and exploiting music production metadata has yet to be leveraged then, but further still, and as we will see in the next part of this chapter, raises an important and fundamental question: what are musical metadata and what is its role in new production processes?

2.2 WHAT ARE METADATA?

At a basic level, metadata are commonly understood as 'data about data', however this definition inadequately conceptualises metadata, as it oversimplifies its real-world character and overlooks a broad scope of uses and issues. The Dublin Core Metadata Initiative (DCMI), a leading metadata authority, uses this 'data about data' definition which is explicated as "resource descriptions" used in information systems to contextualise and describe "objects of interest", for example mp3 files or documents [53]. In this definition, the metadata is conceptualised as a descriptive element in digital information systems that enable objects within a system to be indexed for archive and retrieval. Other concepts go further, for example Duval [71] defines metadata as "structured data about data" and Greenberg [98] as "structured data about an object that supports functions associated with the designated object." These definitions view metadata as an organisational element describing not only the data itself but its relationships to other data and to applications that use that data. Beyond the digital world, Duval quotes an IEEE definition of metadata[6] as "information about an object, be it physical or digital" [70]. Similarly, Sicilia states that "Metadata can be expressed in a diverse range of human and artificial languages and forms… …we can

[6] Reference to discontinued standards document: [IEEE, 2001] *Draft Standard for Learning Object Metadata,* draft 6.1, April 2001 <http://ltsc.ieee.org/wg12/index.html>.

even consider that annotations in the margin of a printed book are in fact a form of metadata." [195]. This inclusion of the physical form for both "objects of interest" and metadata broadens the metadata concept even further: for the music domain these might include instruments, recording equipment, sheet music, physical media, and performances. In the audio domain, Wright [226] brings some of these metadata concepts together and delineates audio data into three layers: 1) raw (audio) data; 2) descriptive data (data about the data); and 3) the metadata, described as "(the) organisation, naming and relationships of the descriptive elements". Wright goes on to posit: "Unfortunately, nobody in audio and video circles uses this definition of metadata, but the author hopes that people will at least begin to think "metadata is the structure of data" rather than the rather-too-simple "metadata is data about data" approach." So far then, metadata are far from being generic, being variously conceptualised as digital or physical information with a role in describing objects; structuring, organising and relating data; supporting data functions; and capturing information about the physical world.

To add to the complexity surrounding the question "what are metadata?", metadata may also be expressed in domain-specific terms, for example describing the properties of time-based media (video) differs from static media (text and images). The heterogeneity of data and its associated metadata raises issues of interoperability [70] which NISO (The National Information Standards Organization) defines as enabling "… the effective exchange of content between systems, (relying) on metadata describing that content so that the systems involved can effectively profile incoming material and match it to their internal structures" [181]. As a user requirement, Tennent, quoted in [38], explains that interoperability should enable users "to discover through one search what digital objects are freely available from a variety of collections, rather than having to search each collection individually". These definitions are uniform with the basic concepts that we have discussed so far, in particular describing data and supporting data functions, however the extent of interoperability required for each data domain can vary [135]. This is reflected in DCMI's four interoperability standards: the lowest levels using 'closed' or narrowly defined vocabularies for domain-specific applications; and the highest levels using more openly sharable, or generic standards [53]. Amongst high-level interoperability standards are sematic web 'ontologies', which Decker [54] defines as "shared formal conceptualizations of particular domains… …(providing) a common understanding of topics that can be communicated between people and application systems.". Despite this definition bearing a striking resemblance to the descriptions of metadata we have come across so far, the literature on ontologies frequently abandons the term 'metadata' and treats ontologies as a separate concept altogether.

What can be gleaned from the literature surrounding metadata is that there is an endless lack of agreement on just what metadata are and that no single definitive understanding exists. As Sicilia [196] states: "…there is an increasing heterogeneity in the ways metadata is defined, created, managed, and stored. This heterogeneity probably comes from the lack of a precise definition of metadata that captures the main elements behind the application of metadata technologies". This lack of precise definition then, raises an issue of how to get a meaningful handle on what metadata are. In the following section then, we cease to trade in abstract definitions and take a different approach that serves to address the central aim of this thesis, to understand the central role of metadata in modern music production, and explore just how musical metadata is invoked, used, treated and understood in the design literature.

2.2.1 A Survey of 'Music AND Metadata' in Design Literature

The body of academic literature surrounding metadata is vast. Google Scholar returns 3.3 million results for the search term 'metadata' and 256,000 results using the term 'musical metadata' [7]. A full survey of this literature is clearly an insurmountable task and so the summary here is limited to searches of design literature in the Association of Computing Machinery Digital Library (ACM)[8]; The Institute of Electrical and Electronics Engineers Xplor Digital Library (IEEE)[9]; and The Audio Engineers Society e-library (AES)[10]. Searching the abstracts and bodies of texts using the Boolean search term 'music AND metadata' yields 232 entries over 161 conference proceedings and 15 journals (see Table 1 for a breakdown).

Table 1 - Literature Survey Totals

Library	*Conference Papers*	*Journal articles*	*Total Entries*	*Conferences*	*Journals*	*Total Publications*
ACM	105	10	115	79	7	86
IEEE	72	11	82	62	7	69
AES	31	3	34	20	1	21
Totals	208	24	232	161	15	176

[7] Google Scholar searches performed 19th February 2018.

[8] https://dl.acm.org

[9] https://ieeexplore.ieee.org

[10] http://www.aes.org/e-lib/

Note the word 'audio' is purposely excluded as a compulsory search term, as this broadens the scope of results to non-musical domains, some examples here include learning objects; moving pictures and sound; spoken word; zoological recordings; and speech annotations of medical records. Although audio and music are intrinsically linked, asserting this distinction in the search term is important to exclude topics surrounding non-musical audio and retain focus on the musical domain. While this approach risks excluding relevant works, the surveyed body of literature on musical metadata was significant enough to yield a range of topics and trends in this field which were teased out in the surveying process.

Categorising the Literature

On the basis of reviewing the literature, it became apparent that there are broad categories at play in the body of academic works regarding the *types* of approaches to research taken; the *domains* which the research addresses; and the *topics* covered in each work. In order to identify trends in the literature, a two-stage process took place in which the abstracts, keywords, and bodies of the text were surveyed, firstly to categorise each text by its type and domain, and secondly to identify the topic(s) covered in each work.

At the top level of categorisation, there are three ostensible *types* of literature surrounding musical metadata. *Models, Evaluations,* and *Studies*. 154 texts (66%) concerned *models*, in which metadata are variously conceptualised and defined in theoretical frameworks, models, standards, taxonomies, vocabularies, or ontologies concerning some musical aspect. 69 texts (30%) concerned *evaluations,* in which metadata-driven technologies are built and tested in closed user experience studies, software trials, or case studies; or experiments, benchmarking, and validation testing. The remaining 9 texts (4%) concerned *studies*, in which end-user's interactions with musical metadata are observed or described in empirical studies including interviews, or surveys surrounding music activities; or analyses of field studies (Figure 5, left).

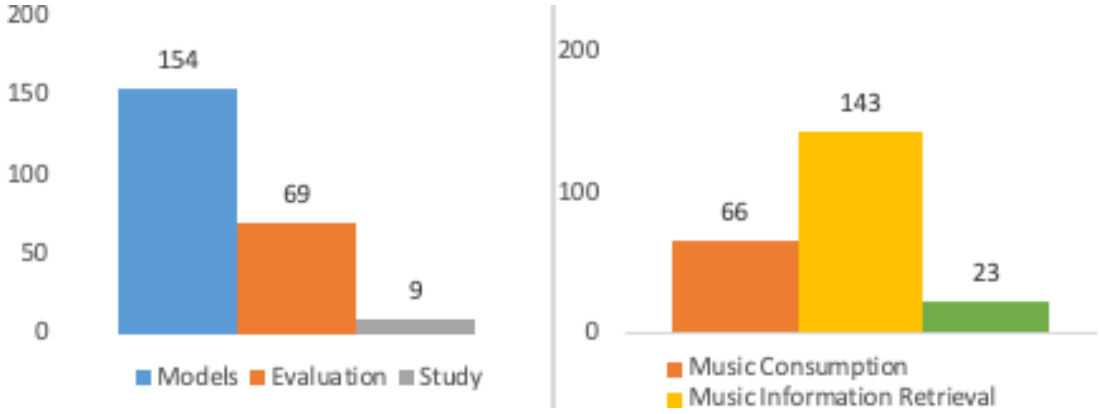


Figure 5 –Breakdown of papers by type (top left) and domain (top right)

Also apparent in the literature are three core domains: 66 texts (28%) concerned *music consumption,* relating to end-user listening experiences, or interactions with live music, or collections of music; 143 texts (62%) concerned *Music Information Retrieval* (MIR) relating to emerging technologies for creating, translating, and interacting with musical data. The remaining 23 texts (10%) concerned *music production* (Figure 5, right)

A cross categorisation of the texts by type and domain, provides a course level breakdown of the trends in the literature that shows prominence in the literature of metadata modelling in MIR (Table 2). A large amount of MIR literature can also be found elsewhere in the proceedings of the International Society for Music Information Retrieval annual conference (ISMIR), however it is important to note that this survey aims to identify *general trends* surrounding musical metadata and so the *subject specific* ISMIR literature is purposely excluded to avoid skewing the results too far toward an already prominent subject area[11].

Table 2 – Type x Domain breakdown of the literature

Type / Domain	Models	Evaluations	Studies	Total
Music consumption	33	30	3	66
Music information retrieval	105	39	2	143
Music production	16	0	4	23
Total	154	69	9	232

[11] http://dblp.uni-trier.de/db/conf/ismir/index.html

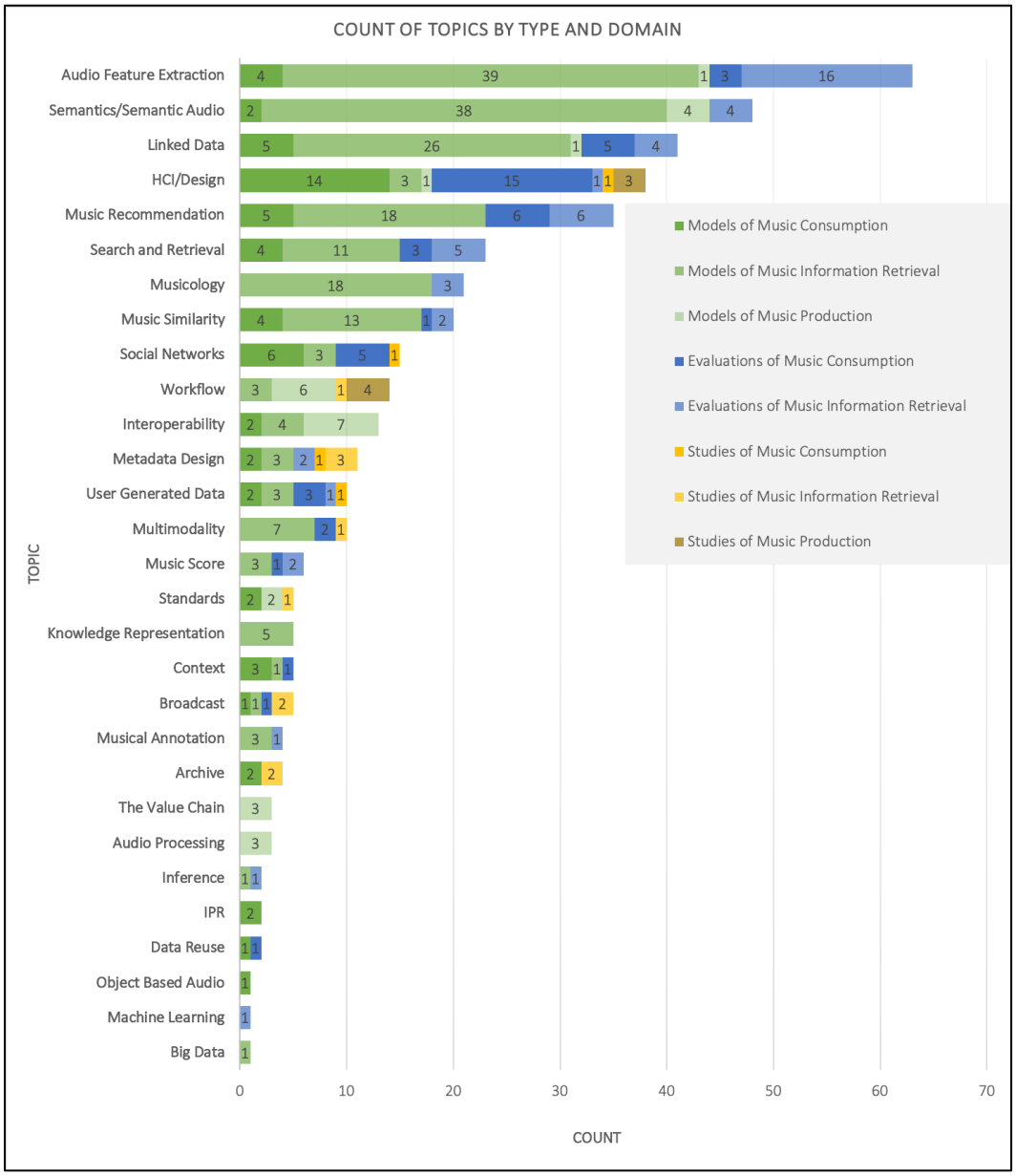


Figure 6 – A tally chart of occurrences of each topic by type and domain

In the final level of analysis 29 topics were identified in the literature, with most texts covering more than one topic. Figure 6 shows a tally of the occurrence of each topic with a further breakdown into categories. The following then, is a summary of the topical trends surrounding musical metadata in each cross-categorised group in which a cross-section of the surveyed literature is referenced to provide examples (note that no papers were categorised as Evaluations of Music Production).

Models of Metadata in Music Consumption

Modelling metadata for music consumption applications is covered in 14.2% of papers (33 texts). HCI and Design is the predominant topic and is concerned with designing novel listening experiences centred on improved recommendation and exploration of music using enriched metadata. Papers theorise on how metadata might be generated or exploited in new ways and used to add different forms of value. Notable examples include: audio feature extraction, for reusing and manipulating music in novel music players [133] and exploring music collections [165]; semantic audio technology for classifying music mood [134]; object based audio for or manipulating music recordings [125,213]; linked data for exploring music collections using novel interfaces [134]; social networks for discovering music events [41,230], and music recommendation [231]; user generated data for improving metadata quality [97] and recommendation [144]; music similarity analysis for *search and retrieval* [127,210], novel listening experiences [83], and handling intellectual property rights [4]; and context aware technologies [201] for playlist generation [16,152]. Papers also contribute more generally to metadata modelling to add value to music consumption in other areas of the value chain including standards and interoperability [100,121,126] and broadcast [145].

Models of Metadata in Music Information Retrieval

Data modelling for MIR is the most predominant in the literature surveyed, covering 45.7% of papers (106 texts). MIR is concerned with enriching and exploiting musical metadata and the metadata models proposed in this field underpin the kinds of metadata-driven application designs seen above. A principal topic is audio feature extraction, which is the automatic analysis of audio content to generate fine grained musical metadata [85] for example musical tuning [113]. A significant proportion of the literature links audio feature extraction to semantics and semantic audio, which combines audio content analysis and textual metadata to attach meaning to musical content and improve metadata quality [9], which can be applied in, for example: classifying songs by musical mood [118,180] and genre [166]; and improving search and retrieval functionality [39,64,65]. These models are variously combined with linked data models, which also feature significantly in the literature [19,205,222], for application in, for example, music recommendation [15,35], musicology [1,177,182], and music similarity [26,220]. Finally a small proportion of the literature uses metadata modelling to account for multimodality of music records [157,188], including analogue music recordings [136,137]; and music score [10,66,214] and lyrics [7], which are also applied in search and retrieval [86], musicology [171] or music recommendation [162].

Models of Metadata in Music Production

Music production features the least in literature on metadata modelling, covering 6.5% of the papers surveyed overall (15 texts). The most prevalent concerns in this category are interoperability and standards [5,121,150,170,197] surrounding the exchange of musical data to both support production workflows and enhance the value chain [42,106]. Other predominant concerns are centred on the effective description of production workflows and audio processing using semantic metadata [30,76–78,82,167,224].

Evaluations of Metadata in Music Consumption

The evaluation of metadata-driven applications for music consumption is covered in 12.9% of the literature overall (30 texts). As with metadata modelling for music consumption, HCI and design is the most predominant topic and features the testing and experimentation of designs, models and datasets. Subtopics include: various interlinks between music recommendation [6,102,124], social networks [153,200,230], contextual data [14,138] and user generated data [158,191]. Included in novel interface designs are visualising music exploration [52,55,212,228,232]; transmitting broadcast metadata through sound [146]; search and retrieval methods for music [24,103] and music scores [69].

Evaluations of Metadata in Music Information Retrieval

Prototype testing and evaluation of MIR is covered in 16.8% of the literature (39 texts). Trends in this category follow those seen in models of MIR and principally surround: audio feature extraction for identifying musical structure [161], song tuning [114,115], rhythm [58]; music transcription [57]; evaluating methods for automatic music recommendation, [75,215]; search and retrieval [40,160,218] using music similarity analysis [112,149] and contextual metadata [189]; semantics for music mood classification [216].

Studies of Metadata in Music Consumption

Studies of music consumption are covered in 0.9% of the literature (2 texts). Key topics in this category are: the observational studies of the role of metadata in searching and handling personal music collections [37] for HCI and design; and ethnographic studies of the use of social networks and user generated metadata surrounding live music events [142]

Studies of Metadata in Music Information Retrieval

Studies of MIR are covered in 1.3% of the literature. Three texts in this category are related to role of metadata in radio broadcast for: the creation of real-world large radio broadcast archive projects [45,128] including the challenge of handling multi-modal data; the flow of work in retrieving sound from audio archives. [147]

Studies of Metadata in Music Production

Finally, music production has the most coverage in the studies literature, but only 1.7% overall (4 texts). All of the texts are concerned with studies of metadata and workflow in real-world music-making activities to inform HCI and design. McGrath et al [156] study the work of music producers in the grime genre, highlighting issues in metadata management surrounding the loss of information in the exchange of musical data between tools and the use of labelling and organisation of sound elements. Ahmed et al. [3] studies of DJ work, reveal the value of metadata in organising song sets for performance, but information is often manipulated or obscured to maintain the competitive advantages of possessing unique or rare music, highlighting professional requirements to hide or switch visible metadata in certain situations.

Outside of the results of the survey, Pestana [172] surveyed professional mixing engineers to test 88 assumptions surrounding mixing practices, to inform intelligent music production; In Pestana's work, assumption 82, *instruments should be well labelled and readily identified*, offers some insight into the value and use of labelling to organise resources. Here Pestana does not specifically refer to the organisation of audio in metadata terms, nor does the study give any first-hand insight as to the reasoning behind organising and labelling audio channels.

Similarly, Brooker and Sharrock [28] study collaborative music-making, revealing that creative processes feature a series of problem-solving activities rather than predetermined workflows, which in turn highlights issues of compatibility and transferability of audio between platforms.

2.2.2 Current Understandings of Metadata in Music Production

Documenting the Process

As stated above, much of the metadata work manifests in annotation practices performed in the real-time accomplishment of producing music. Bobby Owsinski [163] provides an example in the literature of such a practice in the recording studio, in which assistant engineers complete studio track sheets and take other notes to document what audio information is captured to each track, for example instruments or vocals; the technical specifics of the recording equipment configuration for that track; and any artistic instructions made in the process that should be passed on to the next stage of production as a retrospective record that sits aside the process. However, studio session sheets are absent in all of the studies and instead alternative approaches to documentation are present, particularly in the recording studio study, in the labelling and annotation practices that are created and used in the real-time accomplishment of music-making.



Figure 7 - A studio track sheet in use
(taken from https://www.metrosonic.net/a-inside-look-at-gorilla-chiefs-stay-at-metrosonic/)

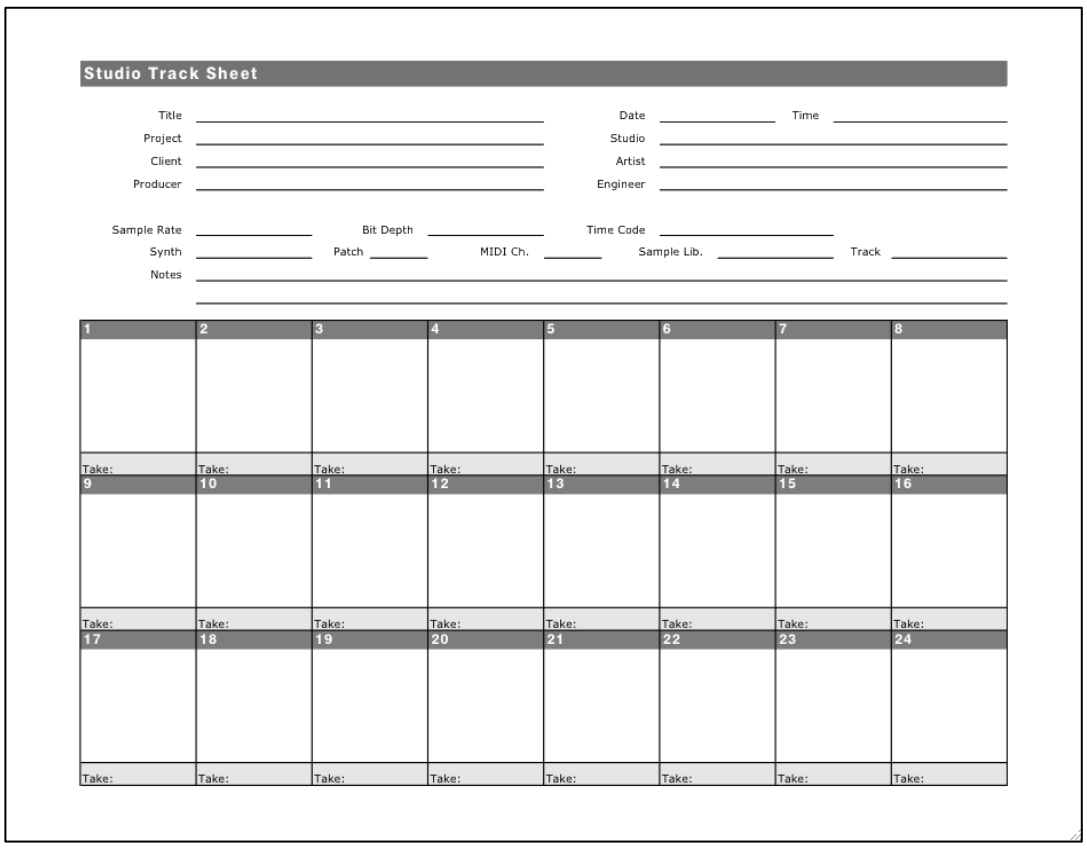


Figure 8 - A studio track sheet example in detail
(taken from http://forums.acoustica.com/bbs/viewtopic.php?p=75912)

Providing for Flows of Work

Another aspect of metadata work in music production featured in the literature is the management and organisation of production resources, namely sound files used to build songs virtually in the DAW in electronic and computer music genres. In McGrath et al [156] study of collaborations between amateur and semi-professional music producers in the 'Grime' genre, sound clip data is stored on the artist's computer in a folder system that groups sounds by theme, labelled using semantic terms such as 'dark' or 'vibes'. Other terms are used to indicate prospective use of sound clip, such as 'hook', or the catchy part of a tune that potentially provides a starting point to build a song around. File organisation supports the process of retrieving sounds for use in the composition activities, however the inquiry stops short of examining the metadata work at the file level and it is here that the home studio production adds to knowledge in this area and provides a unique insight into how these resources are used.

Ahmed et al [3] studies and Lingel's interviews [143] surrounding DJ work, also reveal the metadata work in the organisation of digital music collections, which is distinct from the organisation of consumer music libraries [37,192] in that it provides for a performance work flow through compilations of virtual 'crates' of music and grouping music by genre and tempo. DJing and production of performance is a different orientation to popular music studies than those in this thesis, but is worthy of

a mention here as there is some cross-over in this domain in the home studio study. Firstly, not only is DJ work a feature of the producer's work, but DJing tools and techniques that involve creation and use of metadata to organise sound libraries are also appropriated and integrated into the music production practice. Secondly, as the musical landscape is diversifying, it is highly likely that future work will centre around shifting dynamics between performance and production and recipient design in those areas of work.

Coordinating Work In Situ

Annotation practices feature in Pedro Pestana's [172] surveys of professional mixing engineers, to inform automated intelligent music production technology. Amongst the topics, interviews with engineers offers some insight into the value and use of labelling, grouping, ordering, and colour coding when working with multi-track recordings to clearly and readily identify instruments so that, as one engineer puts it, "… when I start I can get on with musical questions, and not worry about the trivial". It is unclear exactly what the musical questions are, however the studies demonstrate, however, that this kind of metadata work is far from trivial and contribute to insights in this area, not only in the range of activities that the labelling supports in the recording studio study, but also as seen in the project studio study, the kinds of troubles that arise when the organisation of resources is overlooked.

Brooker and Sharrock's [28] studies of collaborative music-making reveal that creative processes feature a series of problem-solving activities distributed across software platforms, rather than predetermined workflows. The study shows details of how the amateur producers create and use annotations with pen and paper and draw upon metadata in the form of waveform graphics as a resource for reasoning about their process as it unfolds.

Metadata Troubles

McGrath et al [156] also explore metadata in the flow of work. In the composition process, much of the artistic reasoning is captured in annotations that are distributed across different devices and mediums (DAW, phone, pen and paper) and include sketched out lyrics and the organisation and labelling of sounds assembled in the DAW. Some of this metadata work is lost in the exchange of the musical data between the two collaborating parties using different platforms and although is recovered in the handover process, the paper only provides a gloss on how this is done. This kind of metadata trouble is also present in the project studio study although this is not due to loss of metadata work but due to its absence – the labelling was never there in the first place. The observations add to knowledge in this area by explicating the producer's reasoning and methods in undertaking the work to translate the artists intentions from the organisation of unlabelled sound elements and reconstitute them toward the work of song development.

2.2.3 Summary

In the first part of this literature review we explored the post-mp3-crisis musical landscape and the impact that digital technologies have had on the entire music value-chain. Burgeoning digital delivery platforms have transformed the music supply chain but disrupted revenue distribution; and digital audio production tools have opened up new possibilities for music-making but undermined the now diminished recording studio sector and its established roles and practices. Meanwhile further innovations are afoot in the digital domain based on the enrichment of musical metadata to drive novel tools for interacting with and experiencing music. The application of metadata driven tools in music production is thin however, which in turn raises questions about just what are musical metadata, what is its role in music-making and how might its value be exploited in novel applications?

So, What are Music Production Metadata?

In the second part of this discussion the question was introduced "what are metadata?" and in attempting to answer, we began with surveying a range of abstract definitions and concepts. These included the basic idea that metadata is 'data about data'; used to describe objects of interest, whether they be digital or physical; a means of structuring data and their relationships; supporting functions that use the data; enabling interoperability and exchange of data between systems; enabling linking, discovery and retrieval of distributed data. This broad base of metadata concepts and definitions do not lend well to clarifying just what metadata are and so to investigate the question further we explored a survey of academic literature to discover the ways in which musical metadata is understood and treated in the design literature.

This survey showed that recent work has significantly opened up possibilities for domain specific vocabularies and subsequent metadata uses. For the music domain, audio feature extraction technologies capable of generating rich metadata from musical recordings open up possibilities further still, whether for enriching musicological archives, enhancing listening experiences, music education, or music discovery and recommendation.

What the survey also reveals is that the bulk of understandings surrounding musical metadata are centred on concepts and models; far fewer understandings are based on benchmark evaluations of these concepts; and a comparative dearth of understandings are derived from real-world empirical study. The aims of this thesis are to contribute to this knowledge gap by undertaking empirical studies of music production and the creation and use of metadata as a resource in its work practices. The subsequent generation of implications for design from these studies open up possibilities for future work that in turn might address the other gaps in the literature surrounding metadata modelling and evaluation of its applications in the music production domain.

Chapter 3
Methodology

This chapter discusses the methodological approach to addressing the research questions through empirical studies of music production and the creation and use of metadata in context. In part one of the chapter we consider the ethnomethodological approach to empirical inquiry and the richness of understandings of human work activities that it yields. In part two, we discuss the uptake of ethnomethodology in systems design as a means to understand work practice and inform system design. To conclude we consider the methodological approach in relation to doing studies of music production work.

3.1 ETHNOMETHODOLOGY

Ethnomethodology (EM) [90] as the name suggests is the study of 'folk' (ethno) methodologies or the methodologies that people use in carrying out their everyday affairs. The term was coined by sociologist Harold Garfinkel, who explains how it came about in his analysis of juror deliberations:

> "Back in 1954… Fred… Strodtbeck… had 'bugged' the jury room in Wichita. He asked me to… listen to the tapes of the jurors… the notion occurred to me of analysing the deliberations of the jurors… these magnificent methodological things… like 'fact' and 'fancy' and 'opinion' and 'my opinion' and 'your opinion' and 'what we're entitled to say' and 'what the evidence shows' and 'what can be demonstrated' and 'what actually he said' as compared with 'what only you think he said' or 'what he seemed to have said'… Here I am faced with jurors who are doing methodology… It's not a methodology my colleagues would honour if they were attempting to staff the sociology department… Nevertheless, the jurors' concerns for such issues seemed to be undeniable… That is what ethnomethodology is concerned with. It is an organisational study of a member's knowledge of his ordinary affairs, of his own organised enterprises, where that knowledge is treated by us as part of the same setting that it also makes orderable." [91 cited in, 31:150]

EM seeks to understand how everyday settings, scenes and events – such as arriving at decisions in a court room or making music in a studio – are methodologically organised by the parties to them. As Garfinkel hints at above, these methodologies are not the kind of thing that a sociologist would 'honour', indeed the sociologist and social scientist more generally may well ignore them and put in place their own methodological apparatus to account for the organisation of everyday life. Garfinkel's interest in members' methodologies thus sits at odds with mainstream social science and opens up a broader critique of social science methodologies that Garfinkel and his colleagues used to shape alternate ethnomethodological policies. At the heart of the matter is 'the missing what' of conventional sociological studies [89].

3.1.1 The Missing What

EM's criticisms of conventional sociological studies turns on the notion of 'the missing what'. Garfinkel cites Harvey Sacks, founder of Conversational Analysis (an approach closely allied with EM in its origins), for the observation that the organisation of everyday life turns upon orderly practices "upon whose existence all previous studies depended, but missed." [92:vi]. Just what are these missed practices? Garfinkel sums it up in reflecting on David Sudnow's criticism of Howard Becker's scenic descriptions of jazz musicians:

> "David Sudnow epitomizes the issue as follows. On the basis of his studies of gestural organization of ensemble musical play he speaks of the "Howard Becker phenomenon" in sociologists' studies of jazz. To take the Becker's studies for example we learn that there are jazz musicians, where they work, who they work with, what they earn, how they get their jobs, or what the audience will request of them. But nowhere in the articles can it be read, and no interrogation of the articles will supply that in just those places, just those persons, with just who is there, and at just that time with the materials and under the circumstances at hand must in and as their local work make music together. A curiosity of the reportage, Sudnow points out, is that Becker's articles speak of musicians' work and do so by omitting entirely and exactly the practices that for those engaged in them makes of what they are doing, make up the recognisably just so, just what, just this going on: making music." [89]

What is missing from conventional sociological studies is the 'work practices' for *doing* the phenomenon under study, be it playing jazz in a club, making music in a studio, or arriving jury deliberations. The notion of 'work' and 'work practice' does not, as Crabtree et al. [47:12] point out necessarily refer to paid labour but to the action and interaction that occurs in any given social situation and the methodological ways in which it is organised locally by the parties to it. 'Work practice' is but another name for members' methodologies, created by Garfinkel to describe EM's 'studies of work' programme. This programme extended Sacks' observation about 'the missing what' to the study of work and occupations, which sought to move beyond the scenic descriptions offered by conventional sociological studies and instead identify what is actually done in the doing of work and how it is methodologically organised by the parties to it. A corpus of ethnomethodological studies of work followed providing detailed accounts of the 'ethno-methods' at work in a diverse array of social situations [92], not that they were well received by conventional sociology. EM was and is seen as a marginalised discipline that sits at the fringes of the social sciences due to its 'indifference' to the accepted methodological apparatus of social inquiry.

3.1.2 Ethnomethodological Indifference

EM's indifference to the accepted methodological apparatus of social inquiry is no accident but a deliberate policy.

> "Soon after our studies began it was evident from the availability of empirical specifics that there exists a locally produced order of work's things; that they make up a massive domain of organizational phenomena; that classic studies of work, without remedy or alternative, depend upon the existence of these phenomena, make use of the domain, and ignore it. It was soon evident, too, that that domain is ignored is not a fault of classic studies but is among its identifying practices. [92:iv]

That 'classic' or conventional studies ignore work practice is an identifying feature of them is provided through the accepted methodological apparatus of social inquiry. Key to that apparatus is 'formal' or 'constructive' analysis (referred to herein as formal analysis), which leverages external theories, models and classifications of human activity to describe the local organisation of work [173]. Thus, formal accounts systematically ignore the 'endogenous' [93] organisation of work, only at best capturing scenic features of its conduct. It is for this reason that ethnomethodlogy adopts and applies as a fundamental principle the policy of indifference to conventional sociological studies, setting aside the substantive insights and methodological advice they offer and instead privileging the reflexivity that is built into action and interaction over the *reflexivity* of the sociological analyst.

3.1.3 Reflexivity

Reflexivity is a critical concept in contemporary social inquiry. Pollner [174] identifies two key understandings of reflexivity at work in the social sciences that highlight the differences in approach between formal analysis and EM. First there is the notion of reflexivity as a tool for 'critical reflection' of the analyst's practices. Termed as academic or *referential* reflexivity, this kind of reflexivity places the social scientist's methods for apprehending the world at the centre of a study, on the basis that the analyst's understanding of the social situation being studied turns upon an appreciation of the practices or methods they have used to arrive at it [61]. The organised character of everyday life is thus rendered a product of the analyst's methods of detecting, analysing and describing its orderliness. These methods are many and varied, ranging from fieldwork, interviews, surveys, diary studies, videography, etc., but all fundamentally turn on the 'documentary method of interpretation' [90] where the particular features of a setting are used as site for viewing general organising features of society according to the analyst's stance [31:78].

Reflexivity as an Analyst's Method

To demonstrate, Button et al. [31:52–53] compare two ethnographic studies of life in the same Mexican village, Tepoztlán, that depict a society in transition from its tribal roots to an urban community, but which give very different analytic accounts of the orderliness of everyday life based on the analyst's predilections. In the first study, Robert Redfield [cited in 31:52–53,179] draws upon his observations to devise a continuum of ideal social typologies from 'folk society' and 'folk culture' through to 'urban society, on which to situate and characterise changing communities such as Tepoztlán. Redfield theorised that social change could be understood in terms of a community's 'acculturation', or its integration of folk and urban traditions in the transition from folk culture to urban society. In contrast Oscar Lewis [cited in 31:52–53,139] depicts a marginalising effect of social change and economic growth, trapping the poor of Tepoztlán in a 'culture of poverty' that displaces them from the structures of mainstream society, and disintegrates their social and familial bonds. Lewis presents a portrayal of social change that creates fractures in society extending through generations, hence the 'cultural' nature of social disconnection and ghettoised poverty amongst the poor. These two depictions originate from ethnographic studies involving the researcher's immersion in the same community, but their theoretical outcomes surrounding social progression stand in stark contrast from one another: one of holistic and integrative social growth; and one of social disintegration and the trappings of poverty. Thus, order resides in the reflexive practices the analyst uses to detect, analyse, describe and interpret the orderliness of everyday life.

Reclaiming Reflexivity as a Members' Method

It is not the documentary method of interpretation that EM objects to, but that the local organisation of work is missed in systematically extrapolating from particular to general through analytic practices of sociological indication conducted in accord with the analyst's intellectual predilections and preferences. The extrapolation leaves nothing but residue, scenic features put to the service of different theoretical interests and arguments. It is for this reason that EM privileges the reflexivity that is built into action and interaction. EM offers an alternate understanding and treatment of reflexivity that reclaims reflexivity as an essential feature of members' methodologies [90,148]. As Pollner & Emerson [175] put it, this *endogenous* or *incarnate reflexivity* is a methodological property of ordinary action and interaction and describes how what actors 'know about' or 'make of' and 'do in' a setting is itself constitutive of the setting and informed by it. For EM, reflexivity has nothing to do with the privileged viewpoint of the sociological analyst but is embodied in members' methodologies or work practices and provides for the 'local production of social order' here in the jury room, the music studio, or the jazz club.

Returning to EM indifference then, for EM the researcher is required to set aside the methodological apparatus of conventional social science and unpack the local, endogenous, incarnate, reflexively 'self-organising' methodologies at work in the setting under study [90].

> "Ethnomethodology proposes, in effect, that the society consists of ceaseless, ever unfolding transactions through which members engage one another and the objects, topics and concerns that they find relevant. These interactions are accomplished as interactants deploy the resources and competencies they possess as members of society, not as sociologists with special insight. The orderliness of social life ceases to be a problem raised and resolved by social theorists but a practically achieved phenomenon 'incarnate' in the interactions and activities of social actors in actual particular circumstances." [175]

As Pollner & Emerson explain, EM indifference is not an intransigence to established social inquiry but is essential to the elaboration of member's methodologies and understanding the incarnate ways in people locally organise the settings, scenes and events that make up a known in the common social world. EM's policy of indifference then, raises the question: If EM reclaims the phenomenon of sociality as that which resides in members' methodologies and not in the analysts' practices, just how can the 'missing what' be apprehended if formal and constructive analyses cannot?

3.1.4 Ethnomethodological Study (Apprehending the 'Missing Interactional What')

> "At a … symposium of the American Sociological Association celebrating the 50th anniversary of the publication of The Structure of Social Action, Jeffrey Alexander called attention to the book's continuing influence upon professional sociology. In the generosity of the celebration, he situated ethnomethodology's program in the agenda of analytic sociology and offered ethnomethodology good advice … he identified for ethnomethodologists the studies they do, advised them of studies they should do, and … In a spirit of generosity … offered ethnomethodology an olive branch. Rather than pursuing their program of current studies … ethnomethodologists should celebrate The Structure of Social Action by returning to the analytic fold. I disagree. There are good reasons for ethnomethodological studies to specify the production and accountability of immortal, ordinary society – that miracle of familiar organizational things – as … local … reflexive … phenomena of order. Among those reasons is making discoverable *one* of those phenomena of order, but only one, namely what analysis incarnate in and as ordinary society, as practical action's locally and interactionally produced and witnessed embodied details, could adequately be." [88]

What Garfinkel is talking about above is how we might apprehend the missing what of conventional sociological studies and make members' methodologies or work practices visible. Put simply, EM studies involve going and looking through doing fieldwork, however it is not sufficient for researchers to simply gather data and report their observations away from the field, as this inevitably produces the kinds of scenic descriptions that we seek to avoid. For example Wyche et al [cited in 31:6.3,227] describe the proceedings of a American 'mega-churches' in which the congregation can be observed to be "looking at screens" displaying bible verse or hymns and

following the service in their hymn books and bibles in "a flurry of paper turning". Such descriptions, however, miss the accomplishment of 'church-going' as an organised and socially ordered affair; after all people do not go to church to look at screens and turn pages, but to share in worship through prayer, song, and sermon (ibid.). Given the inadequacy of mere scenic description raises the question what more do Ethnomethodologists in the field need to do make work practices visible?

Vulgar Competence / Unique Adequacy

The approach that Garfinkel and Weider [96] proposed is for researchers to develop 'vulgar competence' in the ordinary affairs of the setting under study, whether this be a jury room, a recording studio, or jazz club. Vulgar competence bids the researcher to see and understand the world from the participants viewpoint, in order to be able to accurately observe and describe the work of the setting under study in terms of the members methods; an approach that stands in contrast to rendering observations as scenic descriptions that anyone can see. Vulgar competence requires the researcher to immerse themselves in the setting under study, not merely as an exogenous observer, but as someone who is, or aims to be, competent in the ordinary affairs being studied, as they are ordinary to the parties who do them. This does not necessarily require the researcher to acquire the same level of skills as the study subjects, for example a sound engineer or music producer who has developed their methods over many years, but to develop a 'unique adequacy' of concerted competence with members such that the setting's work can be seen and recognised as members see and recognise things [96].

Unique adequacy then is a desired outcome for EM study, so just how might a researcher achieve this in doing field-based study? Pollner and Emmerson [175] advise that researchers should attend to the 'accountable features' that make up the routines of work that members may refer to in glossed over terms.

Account-ability of Members' Methods

> "…an accountable feature refers to the features of a setting as and in the ways they are oriented to (that is, taken account of) and sustained in interaction, practice and experience. Bereft of any theoretically driven criteria of significance or focus, EM's attention is directed to whatever participants take into account." [175]

Accountable features are the competencies and conduct constitutive of a setting's work that are made ordinary in nature and visible to others' so that members can "concert their actions accordingly" [47] in the real-time ordering of their activities. Accountability of members' methods is a fundamental concern for EM that not only asks the question: how do members rationalise and conduct "practical social action"; but also, just how is "practical social action" seen and universally understood by other members? For EM the production of social order is not a specialised activity, understood only by those knowledgeable in the social sciences, but is available to any and all members of society as it is embedded in their everyday activities. This implies that members concerns are placed in accomplishing whatever activities are at hand

and so EM's focus on everyday practical action leads to an understanding of members' practical reasoning, both in how actions are accomplished and in how they are made understandable to others [63:4].

As Garfinkel explains, the ways in which members produce local order are also the ways in which those settings are made 'account-able', or to use another of Garfinkel's phrases "observable-and-reportable" to members.

> "…There is a feature of members' accounts that for them is of such singular prevailing relevance that it controls other features in their specific character as recognizable, rational features of practical sociological inquiries. The feature is this. With respect to the problematic character of practical actions and to the practical adequacy of their inquiries, members take for granted that a member must at the outset "know" the settings in which he is to operate if his practices are to serve as measures to bring particular, located features of these settings to recognizable account. They treat as the most passing matter of fact that members' accounts, of every sort, in all their logical modes, with all of their uses, and for every method for their assembly are constituent features of the settings they make observable. Members know, require, count on, and make use of this reflexivity to produce, accomplish, recognize, or demonstrate rational-adequecy-for-all-practical-purposes of their procedures and findings…." [90:8]

Garfinkel explains just how action is accountable in and of itself, making its features observable and reportable. The recognisability of action in its doing is what makes social life possible: the ordinary nature of action is what makes concerted actions, responses, and interactions achievable to those who are party to a setting's activities. What Garfinkel is saying here is that the accountability of member's action and interaction are not found in meta-narrative - theoretical or conceptual explanations that exist beyond the analysts' observations - nor is it necessarily done through narrative - explanation and scenic description - but in the *in vivo* reflexivity of members' real-time action and interaction.

Making action 'account-able' to others in a setting is methodological achievement for members' and it is the researcher's task to investigate and explicate those methodologies in detail. Sociological theorising and interpretations of action do not help here as this imposes an understanding that separates action from the meaning it has in the course of that action's conduct. This in turn misses the inherent accountability in people's everyday activities that EM seeks to explicate and, as discussed later, that has proven to be of lasting utility to systems design [31:56–57]. For example, Garfinkel also suggests, accountability can manifest in several "logical modes" that research can only make observable and reportable though unique adequacy of concerted competence in the setting's activities. These modes go beyond members' talk, such as in Sacks [186,187] numerous studies of Conversational practices, and can be observed in, for example: *the material*, per Crabtree's [cited in 47,48] studies of communication in the home through organised mail placement; *the embodied*, per Garfinkel & Livingstone's [94] studies of the self-organising character

of people queueing; and *the digital*, per Chamberlain et al [37] studies of organising digital music collections in the home.

The ways in which EM's policies propose that EM study is conducted, through vulgar competence, unique adequacy, and recognition of the accountability of members' methods raises a fundamental question about how field researchers interpret their observations and whether this approach can truly to adhere to EM's foundational principles.

3.1.5 The Question of Interpretation

By way of a summary, the discussion turns finally to address a fundamental critique of EM study: that it is an interpretive methodology and therefore no different to the kinds of formal analysis that it disregards. Returning to the analyst's practices, EM posits that the results of 'classic' social inquiry are theoretical interpretations of social order and so EM sets aside the apparatus of formal and constructive analysis on grounds that it theorises sociality and thus always misses the phenomenon under study. Conventional sociology observes the lived world through its own theoretical lens and aims to index those observations to its theories and literary traditions through the 'documentary method of interpretation' [90], in which description of action and interaction point to the ideas of social systems and structures that underpin the analysts' understandings of the world. For sociology then, observation is inevitably 'theory-laden' as descriptions of social phenomena cannot help but be bound to analysts' interpretations [31:5].

The issue for EM then, is that it also relies on observation and description to investigate the lived world and so a critique of EM indifference might ask: are EM's studies of social order just interpretations too? The answer is yes. EM study describes, in first-hand terms, the accountability that is embodied in observed real-time, real-world, action and interaction; this involves the analyst's interpretations of members methods for *doing* whatever work is under study and just how those methods are made ordinary to those party to the work. In contrast formal analyses are re-descriptions of the world done in abstract terms that overlook the observed action that it aims to analyse (ibid). Thus, EM is *not* an interpretation of the social world, it is a fundamental observation of the missed orderliness in social inquiry and is constituted of a set of policies for getting hold of the missing accounts of interaction on any occasion of inquiry. As detailed earlier in this discussion, EM stands on policies that exist in the literature as just that, *policies*, and not as social theories or schemes of interpretation as provided for in the sociological literary tradition. As Button et al (ibid) explain, EM's focus is on "the practices for correctly observing and describing action – for seeing and accountably recognising any action for the action it is – (that) are built into the action being observed.".

To recap then, EM's policies bid the researcher to emphasise: *members methods*, or the ways in which members of society order their everyday affairs, as they are ordinary to those who are party to them; *indifference* to formal analysis because of its focus on sociological theory and critical reflection of analysts' practices while simultaneously ignoring real-world members methods; *endogenous reflexivity*, or the ways in which members methods constitute the local endogenous organisation of their ordinary activities; developing a *vulgar competence* the in situated affairs under study, such that the researchers' recognition of action and interaction are *uniquely adequate* in concert with members' recognition of action and interaction; and attending to the '*account-able' features*, or the actions, talk, and artefact that members use in the course of action that make action and interaction observable and reportable.

3.2 ETHNOMETHODOLOGY AND DESIGN

Throughout the development of computing and from its early emphasis on computers in the workplace, systems design has incorporated and been influenced by numerous disciplines. Alongside computer science these include mathematics, engineering, arts, psychology, graphic design, and social science. Jonathan Grudin [cited in 31:18–19,101] defines five stages in the history of computer interface design thinking that have incorporated cross-disciplinary working: the first stage included ergonomics driven by a need to fit computer hardware, the dials, knobs, switches etc., around the user and work environment; stage two saw the transition to software programming terminals, leading to; stage three which brought psychology and graphic design into the mix, to design graphic interfaces between the 'end-user' and machine; stage four introduced the cognitive sciences into the development of dialogue between end-user and machine; and in the fifth stage is the "interface at the work setting", or the networking of end-users engaged in cooperative and collaborative work, which in turn introduced the social sciences to design.

The advent of networked computing meant that the social context of work became an important consideration for system design if computers were to fit increasingly distributed work environments. Knowing what a system was to do became the problem for design if it was to effectively support real-time collaborative working and so systems design, led by a few influential research centres, took a "turn to the social" in order to better understand the social contexts that technologies were being created for [120]. This has shaped a tradition of interdisciplinary design practice involving collaboration between social and computer scientists that commonly draw upon 'ethnomethodologically informed ethnographies', which are shortened to 'ethnographies' for brevity in cross-discipline working. This design approach has become progressively relevant as computing becomes a ubiquitous part of social life in and beyond places of work and so the everyday interactions with technology that

pervade almost every aspect of ordinary life are of interest to both sociologists and computer scientists alike [31:61][63:13].

3.2.1 Origins of CSCW

The origins of social inquiry being taken up in the design mix can largely be attributed to research activities at the Xerox Palo Alto Research Centre (Xerox PARC) in the late 1970's under the direction of John Seely Brown who introduced a wider research programme to address the lack of understanding of social context in systems design. The Scandinavian School of Design also acknowledged and addressed this problem and drove the emerging field of Computer Supported Collaborative Work (CSCW), in developing 'participatory design' methods that aimed to include all stakeholders in the development of a system. Xerox also established a European lab in Cambridge and a CSCW centre the University of Lancaster that brought together computer scientists and social scientists to further develop the design research programme. Alongside these industrial and academic research activities, notable failures in system design also contributed to the uptake of the social in system, for example the emergency call handling system implemented London Ambulance Service that led to dangerous and even fatal misdirection of paramedics to emergency incidents [31:26].

These influences drove the uptake of what became understood in system design to be 'ethnographies', involving first-hand investigation of work practices to inform the design rationale behind a system. However, the kind of ethnography initially developed at PARC, owed more Garfinkel's concern with local endogenous ethno-methods and the self-organising character of human activity than the theory-laden ethnography and anthropology as it is practiced in the social sciences (the term 'ethnography' is often contested in HCI, however it is not the concern of this thesis to contribute to these discussions further, only to provide a contextual commentary[12]). Nonetheless the term 'ethnography' and sometimes 'design ethnography' is inevitably invoked in reference to HCI literature and these instances could, and perhaps should, be read as 'ethnomethodological studies of work for systems design'.

[12] See: [31,46] vs [61,62] for further reading.

Respecifying Human Computer Interaction

Lucy Suchman's [203,204] work at Xerox PARC is frequently cited as being seminal in its use of video recorded field studies underpinned by EM, to expose and explicate how assumptions made in the design of a photocopier interface served to frustrate real-world working practices. Suchman compared and contrasted cognitive models of user interaction with empirical studies of what people actually do in practice when doing 'photocopying'. The studies detailed real-time user interactions with a photocopier machine installed with an 'expert help' system designed to display a sequence of instruction when prompted by the users' interactions with the machine, for example opening or closing the document cover. The analysis exposed issues for users resulting from the design of the system labelled as: 'false alarm', or unexpected outcomes of interactions that are undetected by the machine resulting in the users' perceived deficiency in their action; and 'garden path', or an ambiguous action that deviates from instructed action but achieving the same result. Suchman argued that users do not slavishly follow set sequences of action, but draw upon "plans and situated action" or ad hoc strategies that instantaneously direct and organise the activities at hand. [63]. These findings were significant for systems design as they exposed issues in using cognitive theory as it attempted to prescribe human interaction in order to underpin systems design, but more importantly they respecified human interaction from the cognitive sciences to 'ethnographic' social inquiry.

Despite the term 'ethnography' sticking within CSCW and design circles, largely for convenience, the body of design studies that originated from the various Xerox research centres were distinctly influenced by EM [31:27–28]. Ethnography as it developed through Xerox PARC lead the way in breaking out of the lab-based environment, as characterised in its early research, and out into the field to study office environments [203], printshops [27], air traffic control [21,119], underground railway control [109,110]. The Lancaster school, under John Hughes directorship, played a significant role in consolidating EM's role in computing through the COMIC project (Computational Mechanisms of Interaction for CSCW), which sought to promote an interdisciplinary collaboration between social scientists, computer scientists, and systems designers to address the shortfalls in supporting collaborative and co-operative working [31:27–28]. What has followed from these origins is a long tradition of interdisciplinary work that involves not only generating 'ethnographic' studies but rendering real-time real-world work practices such that they are insightful to system designers; and the collaboration with those designers to realise the solutions that they are designing.

3.2.2 Use of EM in Design: Making Work Visible

As has been discussed so far, studies of work are central to EM's programme, however this is also true for many other disciplines. As Sharrock and Button [193:34] summarise, this includes: *economics*, as founded by Adam Smith's notions of "divisions of labour" or the organisation of work for optimal industrial production; *philosophy* and Marx's theories about the human predilection for working our environment; and *psychology*, through its sub-discipline of *ergonomics* that measures and shapes the work environment, equipment, and work itself, around individuals' physical and psychological needs. For this thesis it is not the intention to delve into these areas in any depth, but suffice to say Sharrock and Button's examples ostensibly demonstrate that *work* is a concern across many other disciplines.

Work is also a central concern for sociology, however, as discussed in the first part of this chapter, sociological study is not 'of a piece' and consists of several internal competing analytic orientations that are problematic to the interdisciplinary practice of including social inquiry in the technological design mix. EM, a branch of sociology, has taken on a formative role in informing system design since the early Xerox PARC studies, [47:8], not just in how EM 'fits' as a solution to design issues, but also, and more importantly, because of the understandings of human work activities and settings the studies bring to 'make work visible'. This approach stands in contrast to other methods that ultimately miss the ways that work is actually accomplished: a fundamental methodological issue that runs through such studies centres on representations of work.

Issues of Representation

In order to make work visible, resources such as organisational charts; workflow diagrams; set processes and procedures; and even members' explanations of their own and others' work might appear to be adequate representations of work. However, designers should not appropriate these as description of work, but as depictions of the relationship between an organisation's work and its politics that can be drawn upon alongside empirical study to build understandings of work practices. For Suchman [202], these representations often "black box" work, glossing over of detailed accomplishment of work through simplifying or even obscuring it completely as a representation of an organisational function. This is often an organisational necessity that can come in several forms, such as those listed above, and to capture this Suchman uses the metaphor of maps:

> "In *The Power of Maps,* Denis Wood explores the ways in which as he puts it "maps work by serving interests" [for example, of economic studies, psychology, sociology] In the process, the interests involved in the work of map-making and map-using are effectively obscured, while what is depicted comes to be naturalized as an obvious and disinterested view." (ibid)

Similarly, organisational mapping, for example workflows, procedures etc… serve all manner of interests, whether in establishing organisational boundaries, benchmarking productivity, planning business activities, or providing an account of work practices to others.

A salient example of this can be found in the work of BPR (Business Process Re-engineering): a methodology that emerged in the 1990's that proposes the analysis of situated work practices and a progressive reengineering of work activities, to more efficiently meet the organisation's business goals and to generate requirements for supporting computing systems. Its analytic orientation is 'systematic' in that it first examines the organisation's goals, then identifies *processes*, which are conceptualised as any work activity that "takes an input, adds value to it, and provides an output to an internal or external customer" [105,cited in 183]. These processes are prospectively and logically redesigned to optimise work in support of business objectives, often standardising and culling any work practices that are apparently superfluous to meeting the customers' needs. The work practice inquiries that BPR provides are a distinctly from top-down view that stops in its description of work 'at the level of transaction'. In other words, the analytical emphasis on process, rather than task, provides a "black box" representation of work activities that turns upon the systematic exchange of processual inputs and outputs. Thus, the kinds of ad-hoc and contingent human activities that constitute real-time work practice remain undocumented in attempts to standardise work practice and so are unavailable for informing the specification of systems requirements [49].

The example above demonstrates that many representations of work ignore the accomplishment of work at the expense of outcome, whereas in contrast the use of EM to inform design focusses on how work is done and seeks to make that achievement visible and available to design as a resource. EM returns us to "the missing what" of traditional social study and eschews the 'top-down' approaches to work practice analysis that fail to make the work visible, in favour of understanding how work is done competently [193], as Szymanski and Whalen [206] explain:

> "Making work visible – discovering and describing how people accomplish their tasks, how work actually gets done – reveals what was previously hidden, albeit in plain view. As work practice analysts, our job is to make unbiased observations despite business goals or technology design requirements. If we do our job well, our insights are obvious in retrospect, but by making those insights visible, they become a resource, and we are able to build on them."

Design ethnography then, brings together multiple representations of work, including the perspective of the ethnographer/designer and those who are party to the work, to provide a resource that is integrated into the design mix and used to inform and shape the design and creation of computer systems. The recognition that representations exist from multiple social perspectives can create the foundation for ongoing dialogue and cooperation amongst the various stakeholders and practitioners involved, to produce

adequate representations that are tractable to the design of systems to support that work. In order to do this EM informed ethnography can be drawn upon in several practical ways.

3.2.3 Building the Social into Design

As discussed above, the origins of design ethnography came about as sociologists such as Lucy Suchman were invited to do research in the systems design field at Xerox PARC, however it was a rather by chance that Xerox employed a researcher schooled in EM policy. Although Suchman's work was more aligned to lab-based studies rather than field work required by EM, her work at Xerox formed the first attempts to grasp a methodology for informing design. The work of the Lancaster CSCW centre that followed, marked an uptake of EM informed design ethnographies proper that shaped the techniques and methods for building the social into design. This involved an examination of the ordering of work and the identification of crucial components of work's orderliness that require support through design.

Implications for Design

From these first studies until now, a common output of design ethnographies is the 'implications for design', which are used to point to the importance of findings and provide designers with insight into the accomplishment of work and how a computing system could be shaped to support that work. One of the widely cited first design ethnographies to generate implications for design studied the work of air traffic control (ATC) and provided insights into that work that would certainly have been missed in a conventional requirements analysis [119]. The studies showed that ATC involved collaborative team-work centred on the movement and visibility of cardboard 'flight progress strips' used in a central control room to track and manage airplanes in flight. In highlighting critical features of the detailed and complex flow of cooperative work, the studies were able to subsequently contribute to the design of a more effective prototype ATC system, but were also able to demonstrate the importance of that contribution using design ethnography techniques [21].

Similarly, Heath and Luff's [109] work in the control rooms of the London underground demonstrated the potential of design ethnography. Their studies showed that it was crucial that workers who worked in tandem were fully aware of the each other's activities, which included drawing upon shared resources such as railway line diagrams displayed on the control room wall. From this study, Heath and Luff were able to demonstrate that any control system design should support this kind of collaborative working through shared displays rather than the provision of individual workstations.

Implications for design do not necessarily have to be specific to a design problem and can hold a more generic significance for design. This fulfils a need across the design community to share knowledge and develop good practice, particularly where ethnographic expertise is not directly available. These kinds of findings also provide a more general perspective on social aspects of work and its orderliness that appeal to fundamental modelling of computing solutions. For example, Bowers et al. [27] seminal study of a print workshop demonstrated the disruption to flows of work from systems that are implemented with little or no design consideration for the contingencies and competencies of the members that are party to the work. In Bowers's study, installation of the system across multiple printshops was a contractual obligation for the company on successfully tendering for a government contract, which was built to centrally monitor print jobs and generate accurate billing for the client.

The system was designed according to an assumed workflow: print jobs are assigned one at a time to one print operator who was required to 'key-in' the job details into a system terminal and allocate the job to a suitable machine. This did not reflect the actual working methods in which operators would collaborate locally to schedule and allocate workload by, for example, splitting jobs or anticipating the interruption of low priority jobs to attend to urgent work, or anticipate and attend to issues with machinery. These ad hoc activities were contingent on how the workshop could maintain an efficient flow of work to complete print jobs, however the new system created a considerable overhead in work to 'key in' information leading to overtime hours needing to be worked at one site and on another, jobs were keyed in at the end of the working day to 'retrospectively reconstruct' them.

Although the study examines a specific domain of work, Bowers et al invoke general lessons for CSCW from this study: in designing to leverage the benefits of centralised systems, designers must also apprehend work practices at the local level in order to identify potential organisational tensions that novel technologies might introduce. In creating a new system to fulfil a given business need, designers need to be mindful that any subsequent restructuring of the organisation and its work may need to 'tolerable' in order that any compromises to work practices are not to overly detrimental.

The Design Ethnographer's Role

The work surrounding these, and other early studies shaped the design ethnographer's role: this is not merely presenting a set of field observations and leaving the rest of the development to designers, but rather getting involved in the design process and translating the findings such that designers have clear indications of what to build. This can be done through generating requirements specification documents that provide system designers with a framework on which the system can be developed.

Building a requirements specification usually consists of sets of short statements that are grouped by: user requirements, what it is that the user expects the system to do; and system requirements, the hardware and software components needed to deliver the required system functionality. A full requirements analysis is a far more comprehensive process than just the delivery of user and system requirements and ethnographic findings cannot provide a complete basis for a system specification. However, they can make a significant contribution in illustrating the ordering of work, its social context, and critical features with empirical findings that can be drawn on as a resource in the process of deciding exactly what should be built.

Similarly, design ethnography also has a role in investigating design possibilities in domains where problems are not fully understood or are vague. These are known as 'sensitising studies' and used to orient designers to a work domain, its settings, activities, actors, and knowledge. Sensitising studies centre around what Garfinkel termed 'perspicuous settings' [96] or sites which make the work in a domain of interest available to study. Apprehending the order of a perspicuous setting's work from a members' perspective through sensitising studies enables the exploration of topics and features of work that may in turn open up potential design prospects.

EM as the Analytic Foundation for Design Ethnography

As design ethnography has developed, so too has the dialogue surrounding its techniques and methods. Since the late 1970's EM studies, under the banner of 'ethnographies', have found various semblances of utility in systems design practice and in doing so the boundaries of interdisciplinary practice between EM and computer scientists has shifted and in turn has shaped the kinds of practices discussed above. Building the social into design continues to integrate into design practice, however, this is more than a matter of developing techniques and methods. For example, Dourish [59] emphasises the need for an analytic foundation for design ethnography that can deliver a deeper insight into the social practices surrounding technology than by solely deriving implications for design from empirical study. All the different techniques or methods for working with 'ethnography' are subservient to an analytic and so it is the analytic foundation not implications for design that matters. This raises questions about what this analytic foundation should be?

For Dourish, design ethnography should be built on a traditional 'ethnographic' analytic that emphasises the ubiquity of computing as a driver for the kinds of social inquiry that might aim to address contemporary issues in 'classic' sociological terms [60]. While many socio-technical issues may well be worthy of study and the more 'traditional' kinds of ethnography suited to studying them, the appropriateness of the 'classic' analytic orientation for systems design is questionable. Dourish's position signifies a return to the kinds of social theorising that EM seeks to set aside in explicating the kinds of account-able action that have proven to be of utility to design.

As Button explains, this approach invites the social scientist to usurp the 'expertise of the member' with their theoretical and conceptual interpretations of the social world.

> "In the ethnomethodological approaches that characterise much of design's early engagement with the social, the expertise design is being asked to engage with is the expertise of the members of society themselves who populate the settings that are investigated for design purposes. By contrast 'new' approaches, built upon traditional understandings of ethnography within social science, invite design to engage with the social scientist as expert, where the goal is to replace members' expertise with the theoretical and conceptual machinery of social science." [31:17]

EM's argument then, equates building the social into design to designing for members' methods *not* for ethnographer's methods and so the analytic foundation that matters is a hybrid relationship between EM and design.

Technomethodology

This relationship is coined as 'technomethodology' in articles written by Button and Dourish [32,63], which, it should be noted, somewhat contradict Dourish's later position on ethnographic traditions for design in his writings referenced above. Technomethodology was developed as a means to consolidate the relationship between EM and the design of technology and to reconcile some of the broader issues surrounding the interdisciplinary relationship of HCI and the human sciences. In particular, the introduction of social sciences into the design mix, also introduced a disparate and often adversary array of theories and intellectual concepts for computer sciences to contend with [31:31].

Button and Dourish's technomethodology initiative was built on the recognition that EM informed design studies are done on two main bases: Firstly the "organisation of social action and interaction" as predominantly presented in the body of Conversation Analysis study findings, a discipline closely related to EM, that in particular explicate people's interactions with each other when communications are facilitated through technology; Secondly "the organisation of work" in which EM studies have detailed the ways in which members produce order to flows of work and the impact and role of technology on work practices and methods. From these bases, Button and Dourish propose three ways that EM, the study and explication of members methods, can be built into design centred on elements of the EM approach that technological designers can learn from and build into their design practices:

Learning from Ethnomethodologists, proposes collaboratively drawing upon the EM analyst's experiences in the field and treating them as a proxy for the work in the investigation and evaluation of design proposals. This approach aims to garner the understandings that EM studies can generate before they are lost in the translation to system requirements documentation and become invisible to system developers. This kind of direct collaboration provides designers with the opportunity to learn from the ethnomethodologist's vulgar competence in the field, using what exists in their head

about the work and the work setting to make judgements in response to design prospects.

Learning from EM accounts, requires designers to engage in the kinds of field reports that ethnomethodologists produce to communicate their findings to design. This involves a deeper collaboration than the first approach, as such accounts are not merely presentations of data that have been gathered but are accounts produced from an EM analytic that designers are required to be sufficiently knowledgeable about in order to successfully engage with these accounts. This kind of collaboration moves the relationship between EM and design on through a more formal and thorough means of communicating the EM analysis than a commentary on field observations.

Learning from Ethnomethodology, proposes forging a deeper still foundational relationship between EM and design and moves beyond EM being in the service of design, producing insights into work practices and collaborating in design, to shaping a new 'hybrid' discipline. This requires the shaping of design practice to incorporate EM policies into design and for EM to take on the practical mind-set of design. This integration of practices proposes that design and human sciences can be aligned to approach design problems from an alternative foundational position, one that can reconcile the accomplishment of situated practical social action with elements of generalisation, abstraction, and process in design.

To illustrate this final point, Button and Dourish use the example of file copying to equate abstractions used in design to the 'glosses' that members apply to their everyday working practices, or in other words, the practical social actions that make people's methods observable-reportable and account-able. Similarly, to the end user a file copying function is accountable through the design of graphical interfaces, progress bars and system dialogues that guide the user through the process, but which also provide a gloss for the actual underlying mechanisms for duplicating and manipulating digital data.

> "For the purposes of human-computer interaction, then, the critical observation is this. What computational abstractions share with the abstractions of natural, everyday interaction is that they are organised to reveal certain things (and hide others) for certain purposes. What they do not share with the abstractions of everyday activities is the observable-reportable nature of everyday action which is at the heart of ethnomethodological investigation. Garfinkel and Sacks [95] refer to the mechanisms at work here as glossing practices "methods for producing observable-reportable under- standings... a multitude of ways for exhibiting-in-speaking and exhibiting-for-the-telling that and how speaking is understood" [pp. 161]" [63:16]

Dourish and Button propose computational abstractions move away from the kinds of opaque "black box" representations of computing operations to include more granular view of the mechanism that lies below, still in an abstracted form, but which allows end users to reason and rationalise their interactions with computing machines. For example, a copy operation over a network for a large number of files fails part way through, what might the reasons be and how is this communicated to the user? The

system displays a percentage-done bar, showing 40% at the time of failure, but what does this mean and how does this help the user rationalise about their next action: is the network down, is the destination drive full, which files have successfully been copied if at all? (ibid p.20).

For EM, the observable-reportable nature of human action as it develops, is the key to production of social order, a principle which is largely absent in the abstractions of systems design. Aligning systems design thinking to EM, principally in the accountability of system behaviour, provides opportunities to design computing systems to better support situated contingent human interaction.

3.2.4 EM Studies of Music Production.

The three studies done in this thesis explicate the methods of music practitioners in music creation activities, as a means to build the social into the design of prospective music production technology. The field observations from three different real-world music production scenarios were analysed, to make the work of music production visible through the accountable actions and interactions of members in each work setting. These include the kinds of practical social action that has hitherto been discussed in this chapter and that Dourish and Button term as 'meta-work' (ibid p.16), or the incarnate accountable actions that members display in the unfolding production of social order.

In response to contemporary and extensive interest in the value of metadata in and beyond the Semantic Web and in the nascent prospects of linked data, the studies also examine the role of metadata in the creation and ordering of musical artefacts used in the flow of music production work. The ways in which both meta-work and metadata display the accountability of work practices are examined in all three studies, in particular the multi-modality of these accounting practices, for example: through *talk* in the recording studio and members' interactions; through *embodied* interactions of gestural communication in the recording studio; through *material* artefacts in the labelling and laying out of recording studio equipment; and the *digital* in music producers' methods for organising digital objects, whether used in the composition of a song or archived for prospective use.

In the next chapter, the rationale and practicalities of the studies are discussed in further detail. In short, the three studies aim to give a cross-sectional view of the contemporary musical landscape that has been transformed by the 'democratising' influences of digital technology. The three study settings are then introduced, a *recording studio*, archetypal of a state-of-the-art music production setting; *a home studio* in a domestic setting for a music producer's sole use; and *a 'project' studio*, a kind of hybrid of the two previous settings provided for a geographically local collective of music practitioners. The studies themselves then make visible the work

of music producers in three professional music production scenarios, using the EM analytic orientation that has been set out in this chapter.

Having a semi-professional background in music technologies and the production of recorded music, the researcher's vulgar competence is key to adequately observing and describing the participant's work practices in these studies. Music production is a highly specialised endeavour with very specific jargon and organisational practices that display accountability to the work. In correctly recognising and reporting these features, the studies demonstrate a range of accounting practices in the flow of music production work and also the troubles that occur when these accounting practices are neglected or overlooked. From these findings, several design prospects are identified in the discussion chapter that follows centred on a conceptual DMO (Digital Music Object), which is a metadata-driven digital artefact that aims to enhance the accountability of musical objects, such as sound files or signal processors, as they are exchanged and transformed throughout the music production process.

Chapter 4
Practicalities of the Studies

As a preface to the studies, this section explores the practicalities of doing field work and empirical research around sites of music production. This chapter covers: the rationale for studying contemporary professional music-making; participant recruitment and the challenges of accessing field sites; practical research ethics in doing the studies; and the kinds and amounts of data and the practicalities of data collection. Following this is a brief overview of the three studies that were done including the scenarios; durations of studies; the participants and the field sites.

4.1 RATIONALE FOR THE STUDIES

The reasoning applied in choosing sites of music production for study is based around the core aims and motivations of this thesis. To recap: firstly, digital technologies have vastly broadened possibilities for music creation in and beyond traditional sites of music production, from audio capture, processing and effects, to new performance interfaces, and possibilities for remote collaboration; secondly, metadata as a by-product of music production, is largely discarded beyond the production process, however metadata, both in general and in the production and consumption of music, is progressively being exploited in novel applications to create new value prospects.

Technology such as Digital Audio Workstation (DAW) software has been instrumental making music production accessible and affordable, enabling amateurs and professionals alike to make music in ever diverse locations. The concept of a 'studio' now includes the likes of spare rooms, garages, offices, pub function rooms, and village halls, once they are populated and configured with a DAW and other music-making equipment. Meanwhile, due to digital technology transforming models of music production, distribution, and business revenue, the numbers of commercial music studios continue to decline as professional music practitioners diversify their practices to include non-traditional sites of music production.

Professional music producers then, are increasingly working on musical projects with little budget; optimising whatever tools, equipment, time and space are available; and with no technical assistance or formal management of the process. This is not to say that there is no order to such music-making activities, on the contrary, it is the methods, reasoning, social coordination and collaboration that brings about order and organisation in this domain that are a focus of interest in this thesis.

In contrast, commercial studios are home to state-of-the-art equipment; well-established practices of artists, producers, engineers and assistants; and controlled processes and procedures for handling and archiving music production data and metadata. The design of industry standard DAW software and metadata concepts are modelled around these formalised studio practices, which although are well documented among professional communities are renowned for being made inaccessibility to ethnographic study leaving little possibility to add knowledge about this domain [211].

As professional non-traditional music production becomes more prolific, the opportunity to study a relatively undocumented domain is ideal as means to add knowledge and value to systems design for the contemporary music landscape. The choice of studies then, are rationalised around the following criteria:

1. Studies are of real-world, real-time, music projects, not contrived rehearsals of work practice.
2. Members are music practitioners who draw an income from making music as professionals or semi-professionals.
3. Production work is centred around the Digital Audio Workstation (DAW).
4. Studies are different but complimentary spanning a recording studio, a project studio, and a home studio.

These criteria shaped the search for suitable field sites and participants, however, as elaborated in the following section, this search was not without its challenges

4.2 ISSUES IN PARTICIPANT RECRUITMENT

Several methods were employed to recruit research participants, including: direct requests to personal contacts; direct requests to contacts in an extended music practitioner network (contacts of contacts); gaining access to extended networks through a favour exchange (giving talks on doing research to undergraduate students); posting requests to related academic mailing lists; and posting requests to social media. Of these methods, direct requests to contacts in personal and extended music practitioner networks were the most successful for all three studies, however the search for willing participants and suitable sites for study came with certain challenges that other researchers experienced in doing similar research. On seeking guidance regarding the mired participant recruitment efforts, a more experienced researcher communicated their difficulties:

> "Unfortunately, the problem you are having is exactly the same one I encountered. As I think I said before, this domain has proved to be the most problematic one I've ever encountered for getting decent access to field sites…. …As I see it there are 4 possible routes in: 1) through producers; 2) through musicians who are about to do some recording; 3) through the studios themselves; 4) through record labels / promoters… …The only other thing I can think of is posting ads in suitable publications but, to be honest, if they're reluctant as personal contacts then there's no

> way they'll respond to a general ad. I guess some posts on social media might turn up something, but I rather doubt it will…"
> (Personal communication from Peter Tolmie, 2 November 2016)[13]

This communication and other discussions on the topic reflected the challenges in not only attempting to recruit research participants, but to gain access and *acceptance* to field sites in order to conduct the research as rigorously as possible. The following then are some personal accounts of these challenges.

Timing

Several willing participants identified musical projects that might be of interest to study, however were too far in the future of the timescale of the PhD project to consider; putting research activities on hold to study these activities was risky, given musical projects may be delayed or even fail to initialise.

> "Hi Glenn, Sorry about the delay in replying!
> I'm sure there may be projects that I will be involved in that you could observe - The main issue might be timescale - I wonder over what period this research will continue? I ask because I have one definite project - but its in early stages and won't be at the pre-post production stage for another year!
> I am planning to do something(?) for a performance next spring that will involve recordings and pre/post production - but I haven't decided what it will be yet."
> (Personal communication, potential participant, 26 October 2016)

Project Scope

As per the rationale for the studies, contemporary music production practices in the semi-professional/professional domain are of interest, which meant that some potential field sites were not suitable for study, for example: Access to several student-led projects were offered for study, as many network contacts also work in further and higher education.

> "Does it need to be professionals? I have current 3rd years embarking on mixes for Studio Post Production - could that be of any use?"
> (Personal communication, potential participant, 26 October 2016)

Or projects that included activities that had been observed in previous studies.

> "I have a couple of other projects in the pipeline over the summer… …These will be recording other people, more engineering and mixing."
> (Personal communication, potential participant, 21 February 2017)

Impractical Access

Issues of practical access to field sites occurred when attempting to follow up the Recording Studio Production study through to the mixing stage, in which the engineer

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[1313] At the time of this communication, Peter Tolmie was Senior Research Fellow at the Mixed Reality Lab, University of Nottingham doing field work on music production. Peter and I co-authored and contributed research to a 2017 CSCW paper [155].

edited, treated, and mixed the recorded multi-track audio to produce the songs. Mixing was drawn out over a several weeks in the engineer's spare time and done across different sites on home and office computers and when studio facilities were available, meaning that scheduling fieldwork was near impossible and certain to be intrusive on the engineer's work and home life.

> "There isn't really any post-production left. Essentially, I ended up doing all the mixing at home, didn't have time here. I submitted a set of mixes to the band and am awaiting their feedback. I can go through what I did with each track easily if you want to observe "what I did"?"
> (Personal communication, engineer from recording studio study, 24 November 2015)

Researcher Intrusion and Participant Reluctance

In more than one case, potential participants were concerned that observation of their creative process could cause them to feel self-conscious and unable to perform their work effectively, for example, recording roughly sung melodies to capture and sketch a musical idea. In other instances, willing participants worked in collaboration with other music practitioners who were less willing to be observed at all. These cases clearly presented ethical and practical concerns surrounding the application of observational fieldwork as a research method, so alternative participants were sought.

Mistrust of the Research

Some potential participants stated that in their professional networks there existed a distrustful notion surrounding intelligent music production research that could severely undermine the livelihoods of producers and engineers or even replace them; for example, online automated music mastering services that vastly undercut the fees of professional mastering engineers[14]. Observation of professional practices then, were perceived as a means of informing the development of such tools and so contacts advised it was unlikely that a call for participation among these networks would garner any willing participants.

> "what would be wonderful is if I could have a short statement that I could pass, by email, to producers/engineers that might be interested in helping. Given landr.com, there is a deep, although less spoken about, mis trust in what this work could do for us and I'd advise you to explain as such in the statement.
> (Personal communication, extended network contact, 16 September 2016)

[14] http://www.landr.com

Protection of Intellectual Property Rights

Another barrier to access was a sensitivity to the intellectual property rights of potential participants and/or their clients when original music was being produced. This was particularly problematic in one case in which the engineer would not allow any video or audio to be captured, to mitigate the business risk of music being leaked ahead of its release date. Despite assurances of safeguards against breaches of confidentiality, per university research ethics guidelines, and offers to have university legal advisors draw up non-disclosure contracts, the engineer's ethical duty to the client provided an insurmountable barrier to doing observation at that research site.

> "Hi Glenn, Sorry for late reply. I think we need more discussion before this is going to work. I cannot allow data i.e. audio out of the studio from commercial releases. This is in breach of my duty as the mastering engineer. We need to find a project with either open source copyright or someone willing to engage in the project while equally engaging my company's services."
> (Personal communication, potential participant, 9 August 2016)

Contrived Scenarios

In response to the issues above, some music practitioners offered to give demonstrations of their practice to 'show how I do things'.

> "You can watch me work, but I would suggest you watch, and I explain. My methods are, I believe, unique in mastering (only slightly - nothing ground breaking) and I'd wish for you to understand the context before processing the way I work as a 'given'."
> (Personal communication, potential participant, 16 September 2016)

While offers to contrive music-making scenarios were well intentioned, this potentially eliminated the opportunity to observe interaction and reasoning about collaboration, coordination and cooperation with others involved in real-world musical projects, whether or not they are present at the time of observation. Such offers were politely declined in favour of seeking out field sites in which real-world musical projects were being undertaken.

4.3 THE PARTICIPANTS

The following is a brief description of each study scenario and the roles of the participants who were eventually recruited:

Recording Studio Production Study

The study observes a semi-professional "Retro Rock" covers band producing promotional recordings of their performances in a professionally equipped recording studio in a university. Access to the session was gained through a direct request to the resident recording engineer, who is a personal contact. The engineer in turn acquired a cordial agreement from the band members to allow a field researcher access to the recording session as a condition of the band's free access to the studio.

The six participants involved in the study are: the *recording engineer* who sets up and operates the recording equipment, and coordinates the capture of performances; the *singer*, who sings lead vocal parts of the songs and layers backing vocals on some songs; the *lead guitarist*, who plays the main electric guitar parts of the songs, including chord progressions, improvised melodic embellishments, and instrumental solos; the *rhythm guitarist* who plays electric and acoustic guitar parts of the songs; the *drummer* who plays drum parts on the songs; and the *bass guitarist/backing singer* who plays electric bass guitar parts of the songs and layers backing vocals on some tracks. In addition to these main roles, the singer, rhythm guitarist, and recording engineer share the role of *Co-producer,* which involves planning the recording session; critique of performances; and making informed decisions about the course of the recording activities.

Home Studio Production Study

This study observes a producer working alone to create music for an independent record label run by three partners whose roles are variously: to produce club dance music; perform as DJs with the original music and promote and release the music through portals such as BeatPort[15]. Access to the home studio setting was gained through a direct request to the producer, who is a personal contact. As music sales are not profitable for the label and the main source of income is through DJ work, the producer adapts the production process, through collaboration with partners, to ensure that the music that has impact when played back on large club sound systems and incorporates current musical trends in the genre. Although not observed in the study, this often involves evaluating audience reactions to new or unfinished music and assessing the mix-down of songs in the club environment.

Project Studio Production Study

This study observes part of a production process done in collaboration with a producer and a songwriter, to create a four-track extended play (EP) song collection. Access was gained to a studio session through a direct request to the producer who is an extended network contact. The producer's role in the project is to oversee the production of the artist's compositions from demos to a final product, which includes unpicking the handed over musical compositions, identify elements that can be re-recorded and improved, and polishing the demos to distribute to musicians and attract them as potential collaborators on the project.

[15] http://www.beatport.com

4.4 ETHICS

Prior to recruitment, ethics approval was sought and granted from the university ethics board to conduct field work (see appendix). Further to this, measures taken to ensure that research was conducted ethically included:

Informed Consent

The participants were fully briefed in advance about the purpose of the research and the data gathering methods. Preliminary communications with potential participants were accompanied with information about the research and links to University ethical guidelines[16]. On arrival at a field sites, participants were verbally briefed again; given the opportunity to ask questions; made aware of their right to withdraw from the research; and informed of anonymity and security policies surrounding data. After all information was given, participants were asked to sign a form to give their formal consent (see appendix).

Confidentiality and Data Security

- Any data gathered in the course of the fieldwork, is stored offline on storage devices and kept securely by the researcher.
- In all field reports pseudonyms or role titles are used to refer to participants, to anonymise the data.
- Any pictures or video showing recognisable images of the participants are not used in any published material without the participant's consent.

4.5 FIELD DATA GATHERED

Methods for gathering field data for all three studies included:

- Field notes – actions were jotted down in sequence alongside the time of each entry. As each studio session was several hours, notes were taken in real-time rather than observations being 'written-up' in retrospect;
- Photographs – were primarily taken to document the setting and artefacts of interest that evidence music-making activities;
- video – was used to capture activities in real-time for the duration of each studio session attended. Total approximate run-time of video captured: study of recording studio production - 12 hours; a study of home studio production - 12 hours; a study of project studio production - 8 hours.

[16] https://www.nottingham.ac.uk/fabs/rgs/governance-and-ethics/research-governance-and-ethics.aspx

A combination of field notes cross-referenced with video were used in the subsequent analysis, to pinpoint actions of interest in the video that could be transcribed to the field reports.

4.6 DURATION OF FIELDWORK

In the *Recording Studio Production Study*, the full three-day recording session was attended:

- *Day one setup (four hours)* - Configuring musical and multi-track recording equipment.
- *Day two recording (eight hours)* - Capturing full band song performances.
- *Day three overdubs (four hours)* - Layering backing vocals, and guitar sounds over the band recordings.

In the *Home Studio Production Study*, three studio sessions of four-hours each were attended:

- *Session one (four hours)* - Starting a composition from scratch.
- *Session two (four hours)* - Reworking and updating an original composition.
- *Session three (four hours)* - Mixing-down and mastering two complete compositions.

In the *Project Studio Production Study,* one studio session was attended:

- *Client mix session (eight hours):* Unpicking and remixing the artist's demo compositions.

4.7 THE SETTINGS

4.7.1 The Recording Studio

The setting for the Recording Studio Production Study is an archetypal studio associated with traditional music production, installed with sound proofed rooms and high specification multi-track recording equipment. The studio is in a non-commercial environment (a university) and of a similar size to an independent studio. Three of the studio's acoustically isolated rooms are used in the recording session: The *Control Room* containing the recording equipment; *Live Room One* in which the band perform; and *Live Room Two* in which the singer performs.



Figure 9 - The recording engineer's working position in the control room

The practicalities of doing fieldwork in this recording studio meant that the study is largely restricted to the *interaction observable from the control room*, as attempting to observe action unfolding in other rooms risks introducing unwanted noise, which is to be strictly avoided. Nonetheless the studio layout affords windowed sight lines to the two live rooms, which combined with the audible talkback enables '360° observation' of the session from the control room as the recording engineer sees it from his working position (Figure 9).

4.7.2 The Home Studio

The setting for the Home Studio Production Study is a studio of the type commonly built in domestic locations to drastically reduce the expense and time restrictions associated with hiring large studios or renting spaces for project studios. The studio is setup in one small study room in the producer's home and is centred around a DAW workstation (Figure 10) consisting of: a host PC, keyboard and mouse and large 32" display; two sets of monitor speakers positioned toward a listening position in front of the PC; a MIDI controller keyboard connected to the PC; various DAW software platforms and audio processing plug-ins.

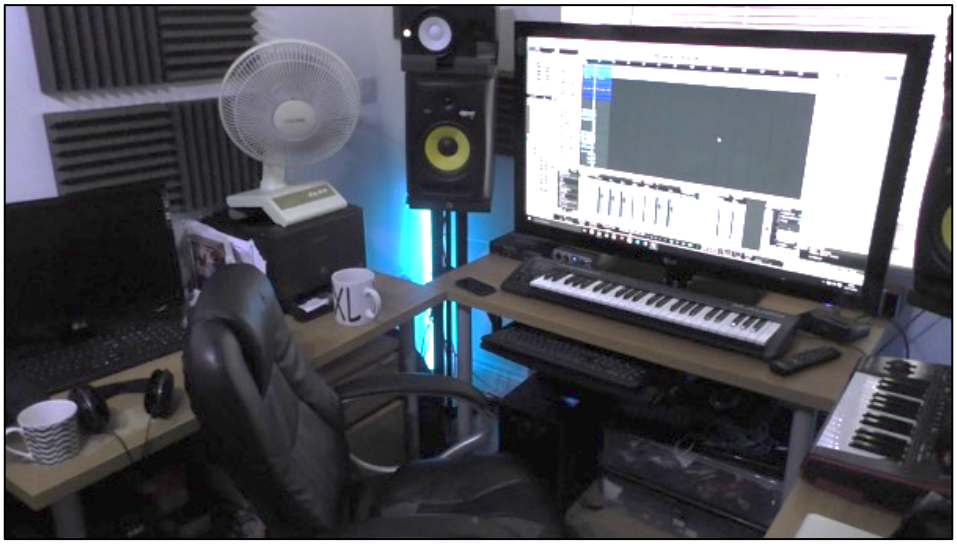


Figure 10 - The home studio DAW setup

Other musical and computing equipment present in the room is not used in the study, but provide a glimpse of other activities evidently done less frequently in the studio, for example: a vocal microphone and peripheral equipment for recording vocal performances; and equipment for practicing DJ performances (Figure 11).



Figure 11 - Equipment for vocal recording (left) and DJ'ing (right).

One of the practical issues of doing fieldwork in this setting is that the producer would predominantly work using headphones to reduce nuisance to neighbours and for detailed listening, however for the purposes of observation the producer used open monitor speakers.

4.7.3 The Project Studio

The setting for the Project Studio Production Study is a type of studio typically built to give its users the affordance of comparatively lower overheads in studio expenses and fewer time restrictions, but in a less well-equipped space than a large studio facility. The project studio is built in a rented business unit, to accommodate a community of music practitioners and their collaborators music production needs that include, for example, composition; recording live instrument and vocal performances; and mixing and mastering songs. Like the home studio, the space is centred on a DAW workstation (Figure 12) consisting of: a host PC, keyboard and mouse and dual displays; two sets of monitor speakers positioned toward a listening position in front of the PC; various DAW software platforms and audio processing plug-ins; various studio hardware used for recording and driving monitor speakers.

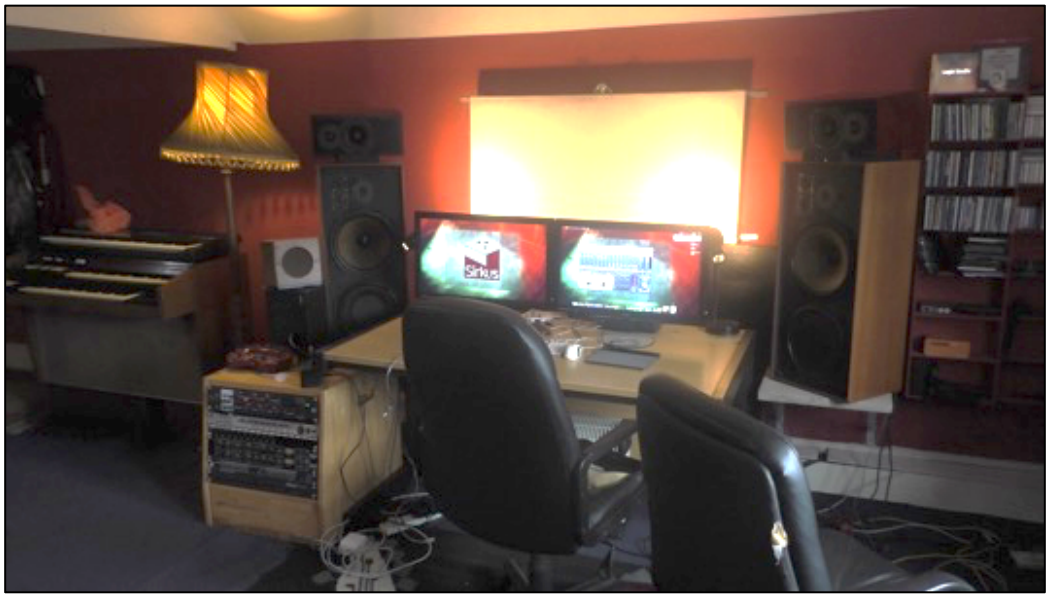


Figure 12 - The Project Studio DAW setup.

Other equipment in the room, not used in the study, include various musical instruments and DJ equipment used in other music production activities done at the studio (Figure 13).



Figure 13 - Other views of the studio showing instruments and music equipment.

Chapter 5
A Study of Recording Studio Production

This chapter presents the findings from a study of recording studio production in a sequence of activities broken down into three main stages. *Firstly*, the setup process, the most substantial part of the findings, details the configuration of actors and equipment and the performance of testing and troubleshooting done to provide for the recording process. *Secondly*, the recording process, in which the setup is implemented and used to coordinate the recording of real-time and performances. *Thirdly*, the overdub process, in which the configuration of actors and equipment is modified to a new orientation of work: layering additional sounds over the recorded performances. For each stage the constituent work practices of the recording studio are described followed by an analysis of the methodological uses of metadata in the process.

Introduction

Recording studios are often characterised as the traditional site of music production, equipped with complex arrays of recording equipment, and home to seemingly opaque music-making practices. However, as we have explored in Chapter 2, the number of large commercial facilities in the recording studio sector has drastically declined, as technologies have enabled music production to diversify beyond the recording studio. Nonetheless, the requirement for recording studios still endures within music production and the recording studio sector is now predominantly made up of similarly equipped but scaled-down recording studios, typically meeting the needs of independent, amateur and small budget musical projects [3].

This shift in scale and character of the recording studio function has inevitably impacted professional practice. It is now common for the traditional roles of engineer and producer to be taken on by one individual, often working without a studio assistant whose role would include documenting and managing potentially valuable information surrounding the recording process [5], as is the case in this study. The study scenario presented here, then, provides first glimpses at what might be considered an archetypal view of recording studio practice in which the engineer/producer is the sole facilitator of the production process in collaboration with the artist.

Another dimension of the post-mp3-crisis impact is that professionals are increasingly also becoming educators to support their livelihoods; a turn of circumstance that opened up the opportunity to a recording studio session at an educational facility. Access to the session was gained through personal contact with the studio's resident professional recording engineer, who formerly worked in a commercial recording studio. The session centred on a semi-professional "retro rock" cover band who had negotiated some studio time with the recording engineer during an out of term period and in return were also agreeable, with informed consent, to participating in the study. Gaining access to the session is particularly significant, as recording studios have largely remained inaccessible to direct observational study largely due to commercial and artistic sensitivities surrounding the work of making records [4], making this opportunity study fairly unique.

The recording session took place over three days during which the recording engineer and the band members collaborated to produce songs aimed at demonstrating and promoting the band's live act. This involved devising and executing an approach to the production work that enabled the band's performances to be captured, in real-time, as an ensemble, in order to produce a faithful representation of their live performances. The observations reported here aim to make visible the real-time collaborations, methods, and roles in the work of recording studio with a particular focus on the creation and the methodical uses of production information, the metadata, in the process. The findings show that these metadata are a coordinative resource that are integral to the recording engineer's work practices to configure the recording equipment for the recording session. This involves both drawing upon labelling information embodied in the organisation of the studio space; and creating labels to annotate the situated organisation of the space. These labels, and other information created in the process, are accountable to the work practices of the production that both retrospectively document the work done and prospectively provide for the anticipated uses of the processual resources that they represent.

5.0 THE FINDINGS

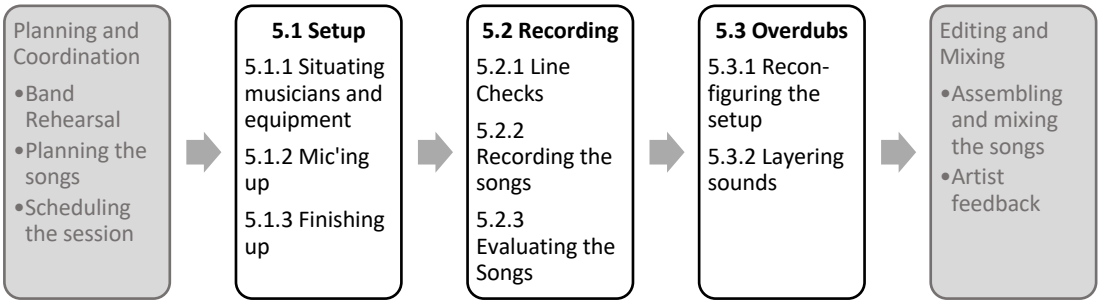


Figure 14 - An Overview of the Recording Process

The findings describe the activities observed in the recording studio as a three-stage process, as represented in Figure 14, which is broken down into the following sections:

- *5.1 Setup* - Describes the activities done to configure and test the studio equipment ready to record the band's performances. This work provides for the artistic and technical requirements of the production and the work of the recording stage.
- *5.2 Recording* - Describes the activities done to record the songs. This involves checking the equipment to both warm-up the band members and refine the recording configuration before capturing the performances as 'takes', which are full or partial song performances. Each take is collaboratively evaluated for musical quality and its subsequent use in assembling the song.
- *5.3 Overdubs* - Describes the activities done to layer additional musical parts sounds over the song recordings. This involves a reconfiguration of the equipment to a new orientation of work in which musicians perform in synchrony to recorded audio, rather than with other musicians in real-time.

These activities not only provide for the job of recording in the studio, but also produce the resources for the editing and mixing stage of the production process that the engineer does elsewhere after the recording session. The editing and mixing and the planning and coordination stage are only secondarily evident from conversation with members in the field and so are not included in these findings

The descriptions of activities in these stages are necessarily glossed over in certain aspects of their detail: recording studios are technically complex and endlessly fascinating places, which in turn has the potential to draw our interest away from our focus on the *social character* of the work and the role of production information used in the process. Following the descriptions of the activities then, is an exploration of the *methodological uses* of production metadata used and created in the process. In order for the reader to gain some appreciation of the kinds of metadata at play in the recording engineer's work, these descriptions are supplemented with detailed figures, tables, and vignettes extracted from transcriptions of the video field data.

5.1 SETUP

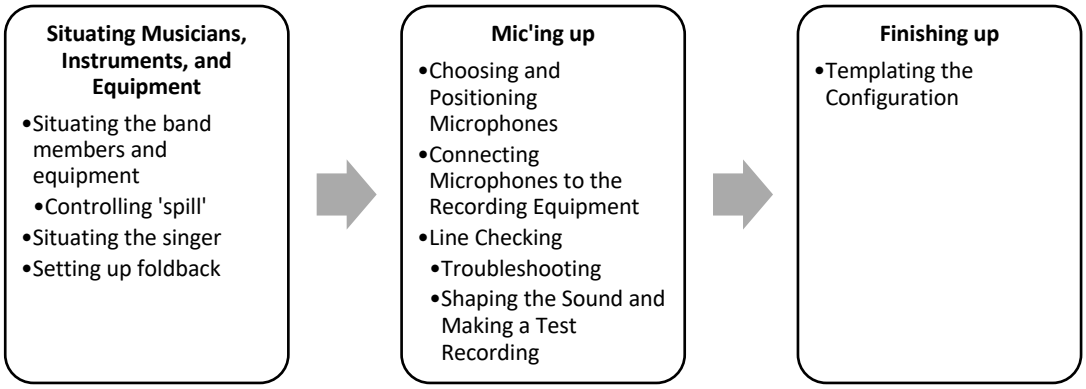


Figure 15 - The sequence of setup activities.

In the setup stage of the recording studio session, the recording engineer and some of the available musicians work together to configure the studio space and equipment to provide for the next stage of the process: recording the band's musical performances and assembling them into songs. This section gives a description of each of the key activities that constitute the setup stage of the process, as summarised in Figure 15 and below.

- *Situating the instruments, musicians, and equipment* – involves a set of tasks to arrange the studio space to meet the musicians' performance requirements, and to facilitate the technical requirements of multi-track audio production.
- *Micing up* – involves configuring and testing the recording equipment to capture the sounds from the band's performance to multi-track audio.
- *Finishing up* - involves finalising the configuration and saving the mappings, labelling to a template in the DAW for use in later stages of the process.

The methods used in these setup activities broadly account for two overarching but competing concerns:

- *Firstly*, that the artistic needs are practically accommodated through a configuration of equipment that allows musicians to perform comfortably and to accomplish their artistic aims;
- *Secondly* per multi-track production practice, sounds are captured as separate discrete layers that in turn provide greater control over shaping and blending sounds into a song.

For the recording scenario in this study, these concerns create a tension between the band's artistic requirements to capture songs in real-time, as they would be performed on stage in their live act; and the technical requirement to separate sound for the production of multi-track recordings. These competing factors account for the practical reasoning behind the organisation of the instruments, musicians, and recording equipment, which we explore next.

5.1.1 A) Situating Musicians, Instruments, and Equipment

Part of the studio setup process involves appropriately allocating performance spaces for each musician in recording studio to accommodate the recording requirements. This involves attending to the following tasks:

- *Situating the band* – involves ensuring the band members can coordinate performances while reducing 'spill' (incomplete separation of sound).
- *Situating the singer* – involves isolating the singer from the band for complete sound separation.
- *Setting up foldback* – involves configuring a system of headphones and talkback microphones used to communicate and coordinate activities.

The accomplishment of these tasks results in a layout that distributes members of the setting across three acoustically isolated rooms (shown in Figure 16), the reasoning and methods for which are explored in the following sections.

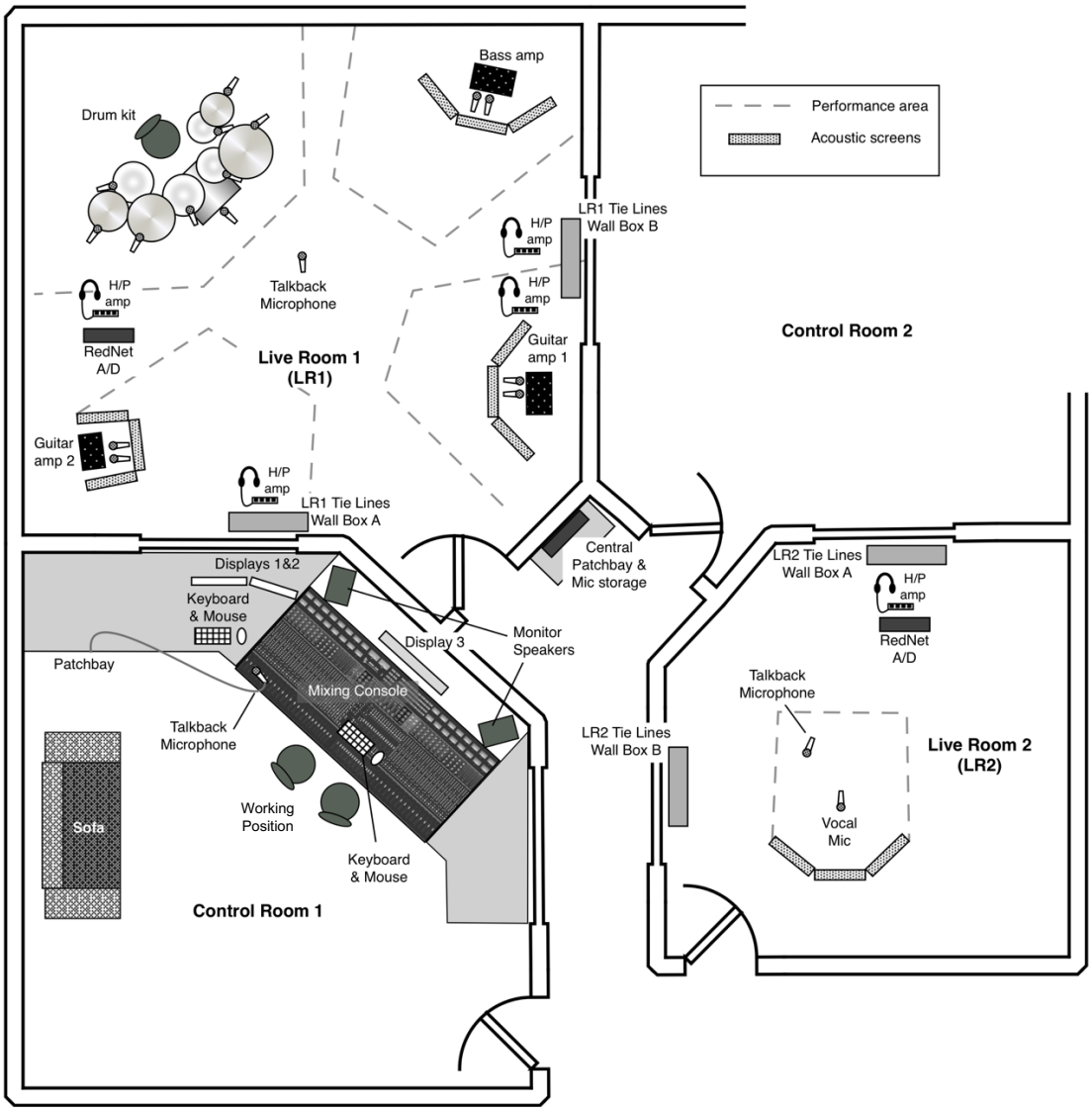


Figure 16 - Plan view of studio layout.

Situating the Band

The recording engineer's reasoning for situating the band in one room is that it presents the best option for meeting the recording requirements in comparison with the alternative method of recording instruments one at a time and assembling the songs in layers; a time consuming technique at odds with the band's requirement to record several songs in the time available. Also, this option does not elicit the kind of real-time ensemble performance that the band wanted to capture, which might typically feature the exchange of gestures, glances, cues, and musical interplay. Capturing performances in real-time and in the same room not only saves time, allowing several songs to be recorded, but enables the band to accomplish their aim of producing songs with a 'live' quality, per their requirement to promote their live act.

Controlling 'Spill'

On balance then, the band's artistic and performance requirements override the need to fully separate instrument sounds, however this introduces a phenomenon known as 'spill', which is when a microphone captures more than one sound to a multi-track layer. To reduce spill, the engineer positions portable acoustic screens around instruments and their attendant microphones to confine the different sound sources. This method does not eliminate spill entirely however and while this is not necessarily problematic it introduces limitations to the production process. For example, the affordances of multi-track recording extend as far as enabling individual performance mistakes to be corrected. Let's say the guitarist makes a mistake in the guitar solo section of a song, then this *could* be corrected by discarding the portion of the multi-track recording containing the solo and re-recording it layered over the remaining layers of the song. However, when spill is present in the recordings this method is not possible as the mistake is indelibly captured in the other layers and may still be heard in the mix and so any performance errors can only be corrected by re-recording the entire band; a method which we will see played out in practice in later sections of this study. The reasoning and methods that we have encountered so far then, not only have a bearing on the physical layout of musicians and equipment, but in shaping the production process, its contingent activities and, as we will explore next, how the coordination of those activities are facilitated with a 'foldback' communication system.

Situating the Singer

Although the engineer employs methods to control spill and organise the process around the problem, the studio is sufficiently equipped to at least separate the singer from the rest of the band. Although this appears obverse to the reasoning we have examined so far, this method accounts for the difference in recording requirements for different musical parts. As we have discussed, spill can be physically attenuated through the organisation of the space, however recording singers involves humans as

the sound source who cannot, and possibly should not, be tightly hemmed in by acoustic panels to reflect and contain sound like guitar amplifiers can. Given the relative loudness of the band instruments compared to the singer, recording the vocal performances in the same room compromises the quality of the recordings beyond what can be tolerated as spill, even in the interests of pursuing the bands requirements to capture the liveness of their performances. Isolating the singer from the rest of the band then ensures the integrity of multi-track recordings but in turn opens a new problem of enabling the band to coordinate their performances; the solution to which is the configuration of a communication system known as 'foldback'.

Setting up Foldback

The job of setting up foldback involves configuring a system of talkback microphones and headphones to create a complete audio communication loop between each of the musicians and the recording engineer. Foldback is essential to the accomplishment of the recording stage of the production as it provides the medium through which members organise and coordinate their performances and recording activities in real-time when they are acoustically isolated from each other. Organising the space and equipment for this purpose to some extent bridges the two competing concerns discussed above: the requirement for musicians to perform in concert and with artistic resolve; versus the requirement to separate sound contingent to the production process. It is perhaps unsurprising then that in the setup stage of the studio session, the recording engineer prioritises setting up foldback and in doing so accounts for three main requirements:

- *Firstly*, each musician can hear a music mix that is tailored to their preference in order to best support their performances, for example ensuring that bass is audible may be a crucial factor in the drummer's performance.
- *Secondly*, that talk is facilitated between performances through the talkback microphones, to enable all members to coordinate the process as it unfolds while situated in acoustic isolation.
- *Thirdly*, that equipment controls are organised so that the engineer can quickly adjust any of the foldback mixes at any point in the process, for example should a musician request an instrument is louder in their foldback mix; and to be able to "hear what they are hearing" through the studio monitors in case of problems. (The latter contingency was not called upon during the session).

Briefly, to set up foldback the engineer places a set of headphones and a headphone amplifier for each musician near to their performance space; talkback microphones in the two live rooms and the control room; and, uses the DAW in combination with other studio equipment to create a complex system capable of sending a customisable mix of audio to each set of the headphones in real-time. In the next section we explore

the engineer's foldback system in more detail and, by way of example, focus on the uses of metadata in organising the space, the equipment, and the process.

5.1.2 B) Uses of Metadata in Situating Musicians, Instruments, and Equipment

To observe the methodological uses of metadata in the spatial organisation of the studio, we now detail the foldback system and how its configuration accounts for both the physical layout of the studio, and the provisional coordination of recording activities in the production process. Mapping audio for the foldback system requires a relatively complex set of connections involving two patch bays, including a central patch bay, to route audio between the two studios and the control room (Figure 17).

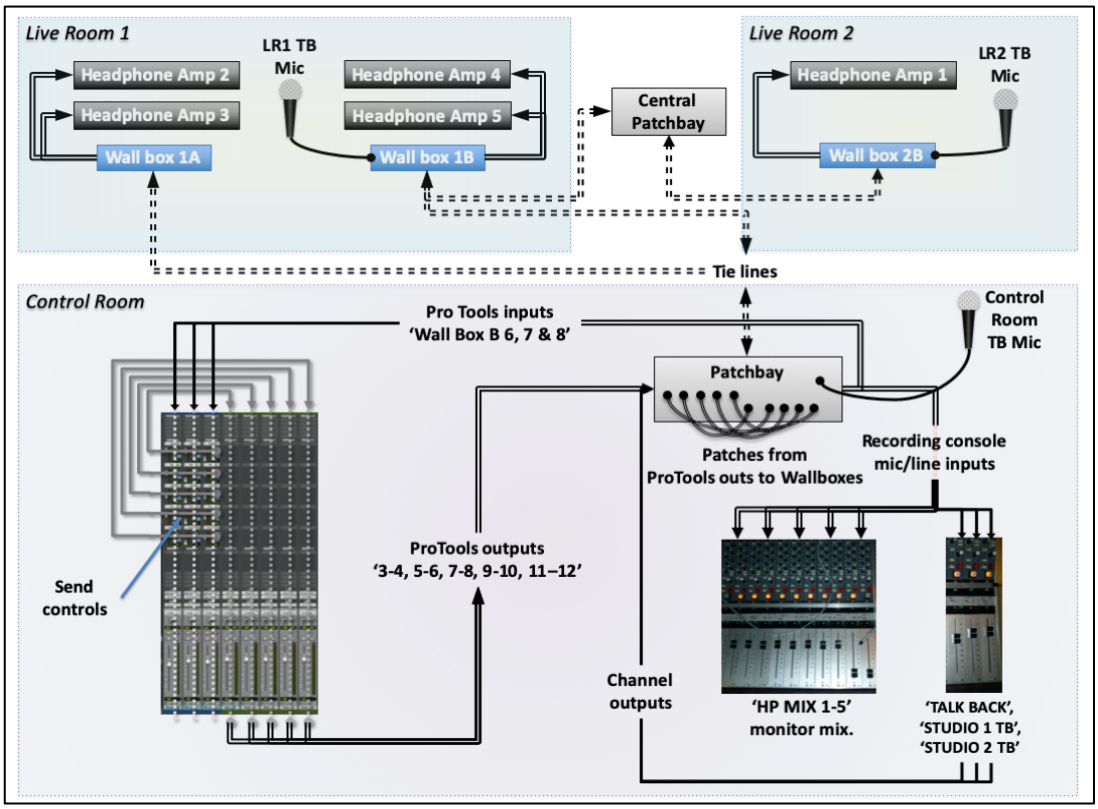


Figure 17 - Simplified schematic of the foldback system.

The metadata that the engineer draws upon and creates in producing this configuration is typically encapsulated in the labelling inscribed on the studio equipment that denotes the numbering of discrete audio channels; the input and output connections to and from the equipment; any preconfigured interconnections between equipment; and any other descriptive information used in the audio mapping process.

Mapping Audio to the Spatial Organisation of the Studio

These metadata can account for the spatial configuration of the studio and are used, for example, to route the custom headphone mixes from the DAW to the headphone amplifiers connected to wall boxes in the live room (Figure 18).

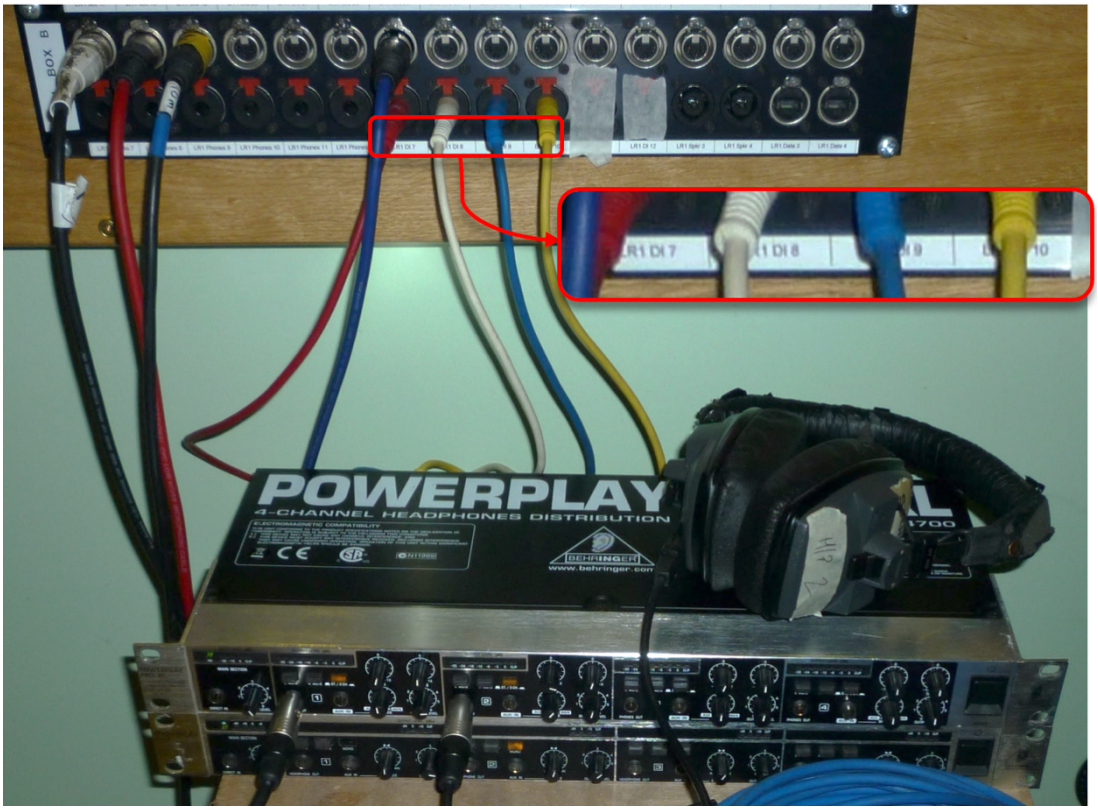


Figure 18 - Wall Box B in the live room connected up to headphone amplifiers allocated to the guitarist and the bass player. Inset – the labelling applied to the tie-line connections (LR1 DI 7, LR1 DI 8, etc…).

This involves using the studio patch bay to create new signal paths between equipment, drawing on the labelling to patch pairs of DAW outputs through to numbered connections to the wall boxes, known as tie lines. Figure 19 details the labelling used to configure the patches, which include information about the destination of audio connections ("Wall box A" or "Wall box B"). This simple piece of labelling provides a coordinative resource that the engineer draws upon to map the audio configuration to the space; in this case so that the headphone mixes are sent to whichever wall box is closest to its recipient musician.

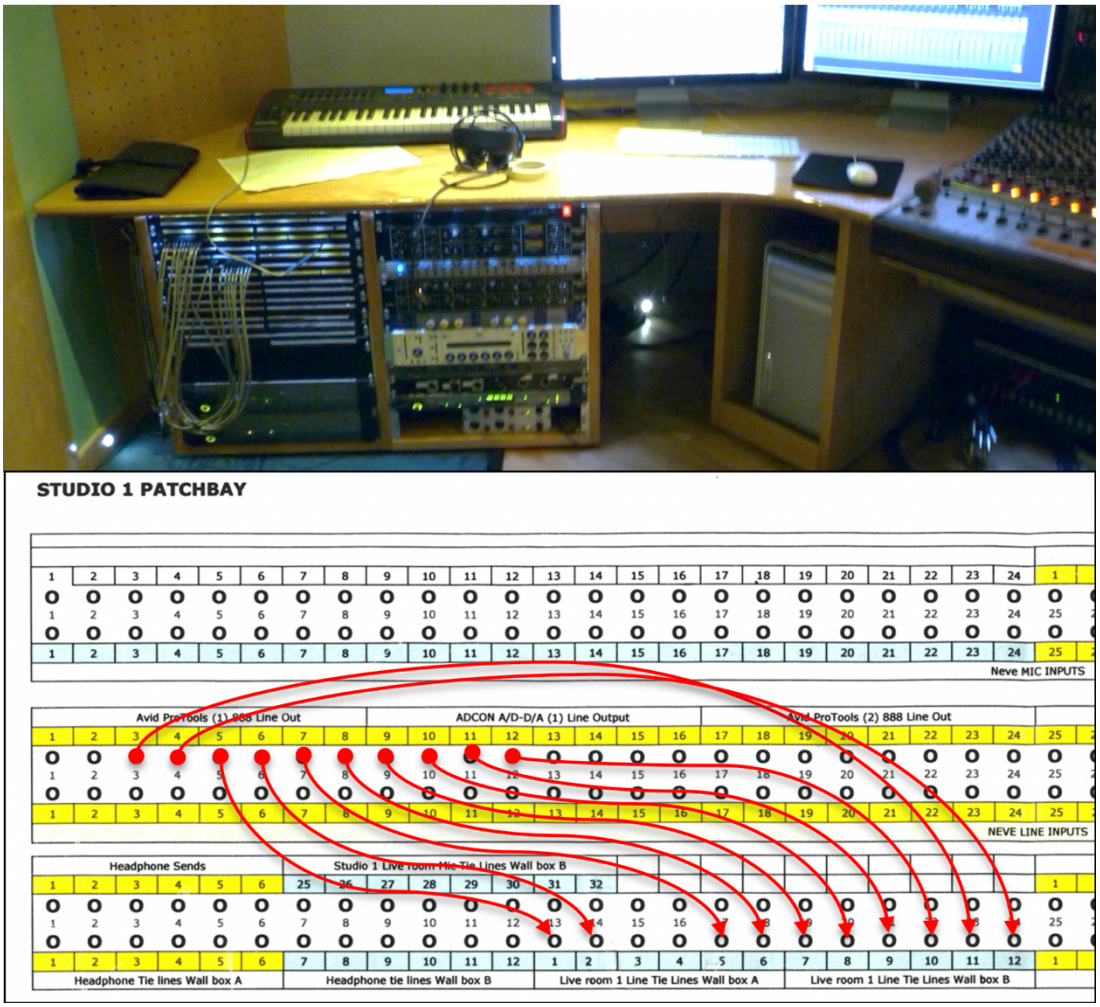


Figure 19 – The control room patchbay with patch cables connected (top) and a detail of the patch bay plan (bottom) with schematic of patches used to map the headphone mixes from the DAW to the Wallboxes.

Table 3 - Labelling used to patch headphone mix audio to headphones.

DAW O/P	Patch bay Label	Patched to Connection Labelled	Wall box Label
A 3-4	Avid ProTool (1) line out 3-4	11-12 Studio 1 Live room Line Tie Lines Wall box B	LR 1 DI 11-12 *
A 5-6	Avid ProTool (1) line out 5-6	1-2 Studio 1 Live room Line Tie Lines Wall box A	LR 1 DI 1-2
A 7-8	Avid ProTool (1) line out 7-8	5-6 Studio 1 Live room Line Tie Lines Wall box A	LR 1 DI 5-6
A 9-10	Avid ProTool (1) line out 9-10	7-8 Studio 1 Live room Line Tie Lines Wall box B	LR 1 DI 7-8
A 11-12	Avid ProTool (1) line out 11-12	9-10 Studio 1 Live room Line Tie Lines Wall box B	LR 1 DI 9-10

*** This audio connection was mapped forward to Studio 2 in a 'daisy-chain' arrangement via the central patch bay, which was inaccessible during the recording session. These labels are missing from the field data, this does not impede the illustration of the recording engineer's mapping practices.**

Mapping Audio to Organise the Control Room

Labelling is also drawn upon to map audio to the spatial organisation of the control room, in particular the huge array of controls on the 48-channel recording console in the control room (Figure 20). Depending on his preference, the recording engineer maps audio sources to channels according to their longitudinal position across the console, for example, the three talkback microphones are mapped to channels 46-48 furthest to the right.

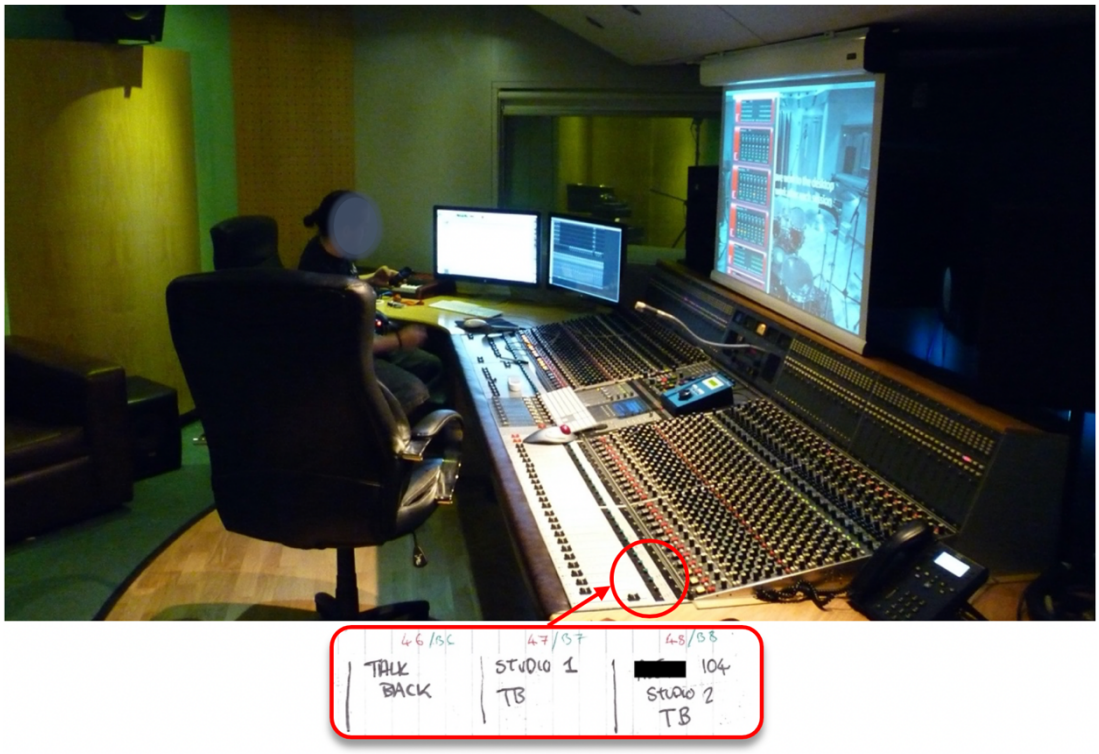


Figure 20 - Side view of the recording console located in the control room.
(Inset: labels applied to talkback channels 46-48. The singers name is obscured).

This ensures these controls are "out of the way" of the recording engineers working position when working with other audio controls but are also easily navigable for switching on and off: Talkback microphones are frequently turned off during the course of the recording activities to ensure there are no audio signals that might interfere with the recording engineer's need to do critical listening of audio from the instruments. The role of metadata for mapping audio to organise the control room can similarly be observed in the configuration of other audio sources, which will be detailed in due course, but also integral to these methods is the creation of metadata through the methodical application of labelling to the recording equipment (shown in inset Figure 20 and detailed in Table 4), a practice which we will examine in closer detail next.

Table 4 - Labelling used and created in configuring the talkback microphones.

Talkback mic location	Connection Label (and location of label)	Console Ch. No.	Console Ch. Label
Control room	Neve MIC INPUTS 46 (Ctrl rm Patch bay)	46	TALK BACK
Live Room 1	LR 1 MIC 23** (Live rm 1 Wall box)	47	STUDIO 1 TB
Live Room 2	LR 1 MIC 24** (Live rm 2 Wall box)	48	(CHRIS) 104 STUDIO 2 TB ***

**Numbering of microphone connections from the wallboxes to the recording console are offset by 24 (Channels 25-48 relay audio to DAW inputs 1-24; channels 1-24 are handle the DAW outputs 1-24)
*** "104" refers to the microphone model (Nuemann TLM 104).

Annotating for Retrospective-Prospective Coordination.

The recording engineer's labelling is displayed as both physical and digital annotations/metadata that exhibit an accountability to the orderliness of the work that can be thought of as a 'retrospective-prospective' in character. Annotations are created as a resource for retrospectively documenting the allocation of audio information to an audio channel and the details of the recording configuration, which the recording engineer does, as he put it, "instead of taking notes". Simultaneously, the annotations prospectively display accountability to their anticipated future use. For example, Figure 21 shows part of the physical labels that are handwritten on a strip of masking tape stuck across the front edge of the console to denote channels allocated to the foldback system.

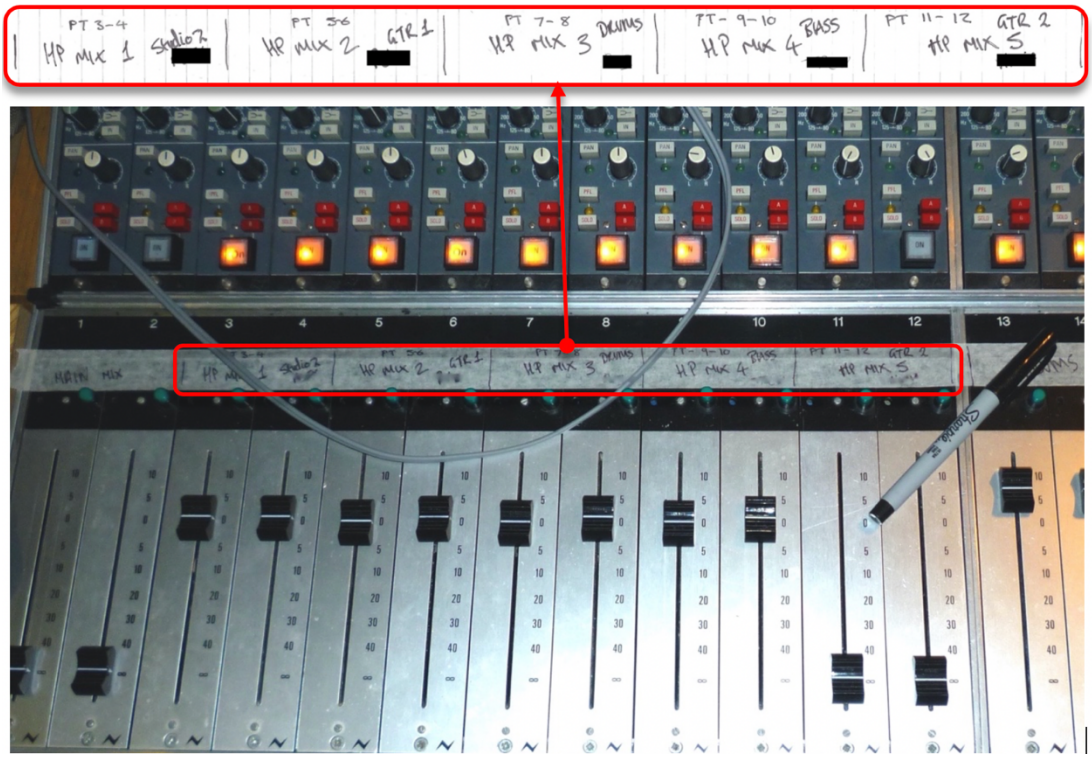


Figure 21 – The labelling strip on the recording console and (inset) details of the annotations applied to the recording console (musician's names are obscured).

These annotations firstly, account for the mapping work between the DAW outputs and the recording console channels (labelled as “PT 3-4”, “PT 5-6” etc…); and the subsequent allocation of these as headphone mixes (“HP MIX 1”, “HP MIX 2” etc…) to band members in their roles (“DRUMS SIMON”, “BASS ALAN” etc…); and secondly, provide for the navigation and location of controls which, in this case the recording engineer anticipated were needed to make the headphone feeds audible in the studio monitor speakers so that he could “hear what they’re hearing” in case of trouble.

The recording engineer also labels up elements of the foldback system in the DAW ‘mix-view’, which emulates a real-world recording console and can be similarly labelled and annotated with digital text, as shown in Figure 22. The audio elements in the mix view be can flexibly arranged to create a virtual view of the recording configuration, which is an affordance that the recording engineer uses, in combination with the labelling (inset Figure 22) to create a matrix-like arrangement of controls for managing the musician’s headphone feeds: each sound source is represented vertically as a virtual channel and controls for sending audio to each headphone mix are aligned horizontally across.

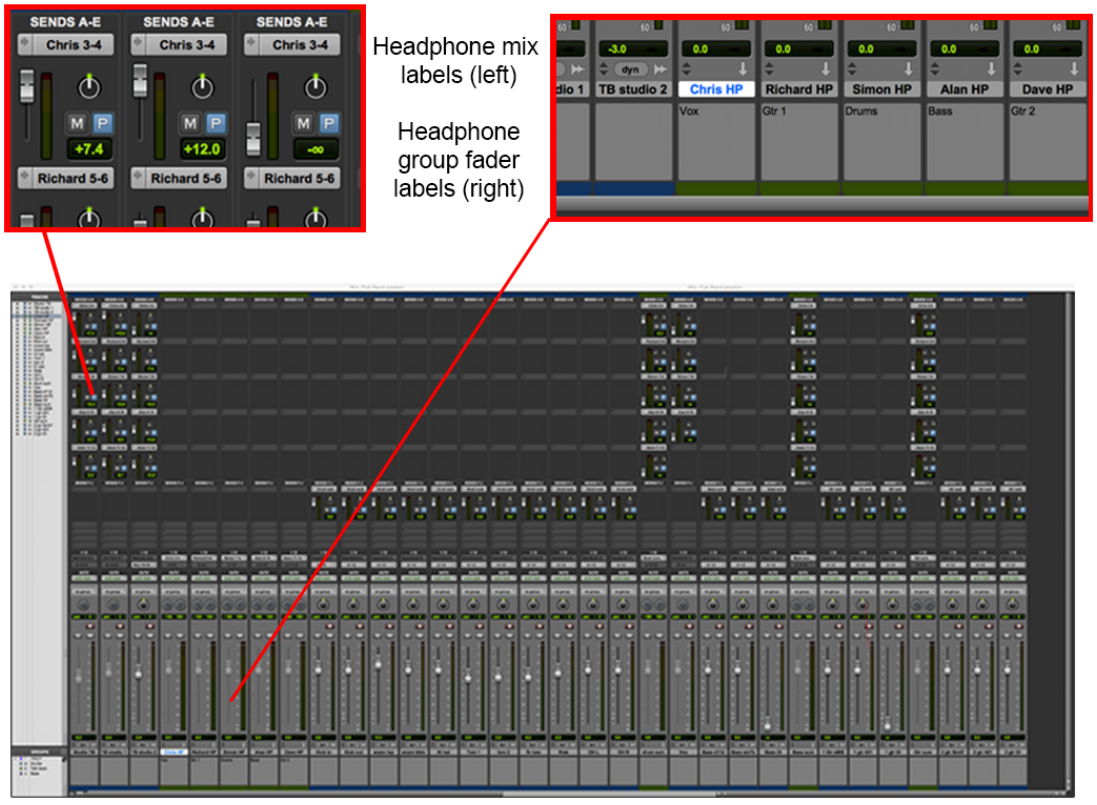


Figure 22 - The Pro Tools mix window. The controls in the top five rows send instrument and talkback audio to each musician's fold-back mix.
(Screenshot is adapted from original DAW files to psuedonymise original data).

In Extract 1 below the recording engineer comments on the value of organising and labelling the elements of the foldback system in this way while preparing to record a song during which musicians request refinements to the mix of sounds in their headphones (Figure 23).

Extract 1 – The recording engineer (Paul) reasons about headphone mix labelling

Paul: This kind of boring shit like going through yesterday going through naming everything, naming all the I/O (Inputs/Outputs/busses) stuff like that, it's invaluable because it's so much quicker now. It's like if I want to… you know… the I/O instead of it being labelled "Bus 1 and 2" it's labelled by person so you know when he says, "I want a bit more (guitar) in my headphones" it's like; [gestures imaginary mouse pointer operating a fader with finger] Chris (singer), boom, that up!... …you know…"



Figure 23 - The recording engineer makes adjustments to headphone feed during the recording session.

What this extract reveals is the retrospective-prospective character of the recording engineer's organisation and annotation of the foldback system and his practical reasoning about its anticipated use when doing the configuration work, of which there are practical examples detailed later (see pp. 92). This retrospective-prospective character is a grossly observable feature of the metadata created in the setup stage that occurs for other aspects of the configuration. In the following sections, we continue to explore the setup work and ways in which the metadata generated in the process are accountable to its anticipated role in the production process.

5.1.3 A) Mic'ing Up

The job of 'mic'ing up' includes a set of methods aimed at capturing the sounds of musical performances. In brief, this involves:

- *Choosing and positioning microphones* - to pick up sound from the instruments and the singer, accounting for a number of situated key concerns.
- *Connecting and mapping microphones to the recording equipment* - which is done methodically to organise the audio elements such that they are grouped and labelled to prospectively support the recording process.
- *Line checking* - to test each audio source, troubleshoot and resolve any problems with the configuration, and shape the sound of the instrument

The specific methods for mic'ing up are contingent to the situation, the type of instrument being recorded, and the artistic aims of the production. In the following sections then, we examine just how these concerns are accounted for in the observed mic'ing up methods.

Choosing and Positioning Microphones

The mic'ing up process begins with the initial choice and placement of microphones, which involves practical reasoning surrounding three key concerns:

- *Firstly,* that the appropriate types of microphone are chosen – some are designed to be specifically used on certain instruments or for certain situations.
- *Secondly,* shaping the sound of the captured audio – this can be done through choosing a microphone type that generates a certain tonal characteristic, or simply positioning the microphones to focus the different tones of an instrument's body.
- *Thirdly,* to provide contingency – if recording capacity allows, additional microphones and other methods of audio capture (see DI Box in glossary) can be configured to give options to shape, reshape, or re-engineer the sound later in the production process.

In the following examples we explore how the recording engineer addresses the concerns above for each of the instruments in turn:

Drums

To mic up the drums the recording engineer uses microphones designed to be resilient to loud instruments that can be positioned very close to each piece of the drumkit, without risking microphone damage. This in turn reduces spill as the microphones are less open to pick up other sound sources, as is the appropriate mic'ing up method for the situation (Figure 24).



Figure 24 - Microphones positioned around the drum kit. Note the talkback microphone (foreground bottom left).

Microphone positioning is also employed to shape the drumkit's sound. Two microphones are positioned on the kick drum, one outside and one inside the drum, to produce, as the engineer put it, "click" and "thump" elements of the sounds respectively that are blended to shape its sound. Similarly, two microphones are positioned on the snare drum, one above and one below, as this type of drum uniquely has a bottom drumskin over which metal snare springs are stretched to give the drum its signature "crack" sound, in addition to a standard top drumskin, often tuned to have a "ring" sound. Finally, microphones are also positioned 'overhead' principally to pick up the cymbal sounds but also to capture the overall sound of the drums for contingency, although these microphones are particularly susceptible to spill.

Two Guitars and the Bass Guitar

For the guitars, microphones are also chosen that are designed to be positioned closely to loud guitar amplifiers in order to reduce spill. Here the recording engineer deploys two different microphone types for each amplifier that are chosen for their tonal qualities (Figure 25) including, in one case, a 'vintage' microphone used (albeit unsuccessfully) to create a 'classic rock' guitar sound. This configuration provides options to blend the different tonal qualities to shape the guitar sound, or the contingency to reject a microphone feed altogether should the captured tone be considered unsuitable later in the mixing process. To provide further contingency, the recording engineer also uses a DI Box to capture the unamplified audio directly from each guitar (Figure 26), which provides further options to re-engineer the recordings of the guitar through a process of 're-amping' if necessary (see glossary).

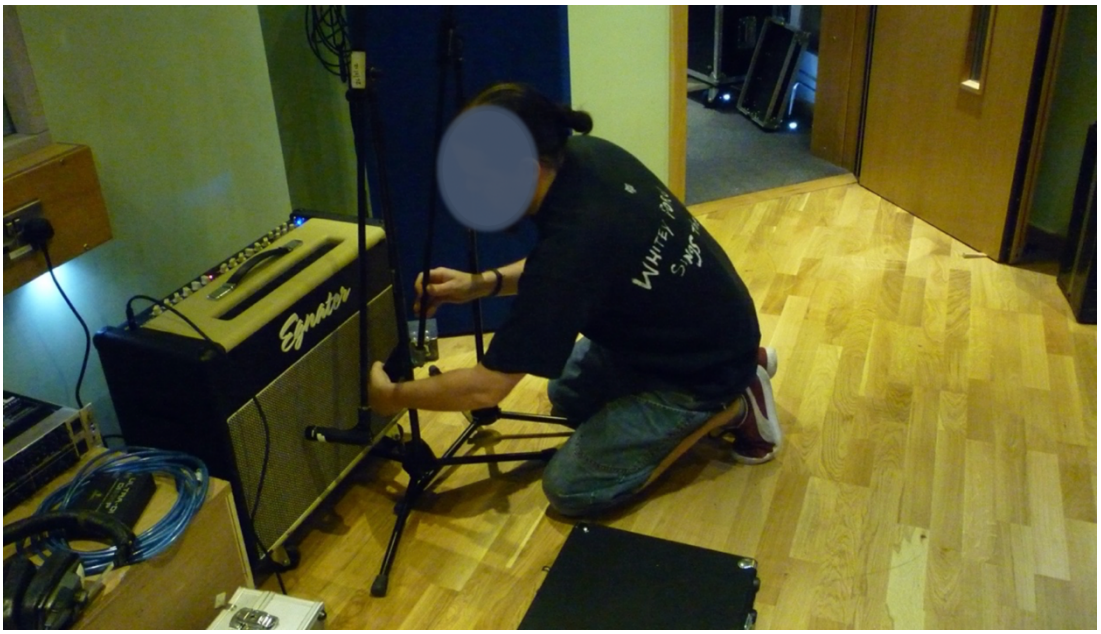


Figure 25 - The recording engineer positioning two microphones on the second guitar amplifier.



Figure 26 - The recording engineer connecting up a DI box.

The Singer

Finally, for the singer the recording engineer chooses a microphone that he considers appropriate for the situation as its tonal qualities when used to capture vocal performances are known to be suited to the musical style. The microphone is also known to have "low handling noise" or sounds transmitted through the microphone casing when being handled by a performer, should the singer feel more comfortable holding the microphone when performing. The vocal microphone then, is simply placed on a stand in a separate room, as detailed in the previous section, but also positioned amongst acoustic screens placed around the singer's performance area to reduce the reverberation in the room that the microphone might capture; again a way of using positioning to shape the sound (Figure 27).



Figure 27 - The singer mic'ed up in situ (note the placement of acoustic screens, including one mounted on the microphone stand; and a seperate talkback microphone to the left).

Connecting Microphones to the Recording Equipment

Once microphones are in position, the recording engineer connects cables between the microphones and one of two different interfaces for relaying audio from the live rooms to the recording equipment in the control room. The first of the interfaces are the audio connection sockets mounted on the wall boxes in the live rooms, which we have already seen in previous sections; and the second is a piece of hardware called 'RedNet', which is an analogue to digital audio interface that streams digitised multi-channel audio directly to the DAW via an ethernet connection (Figure 28).

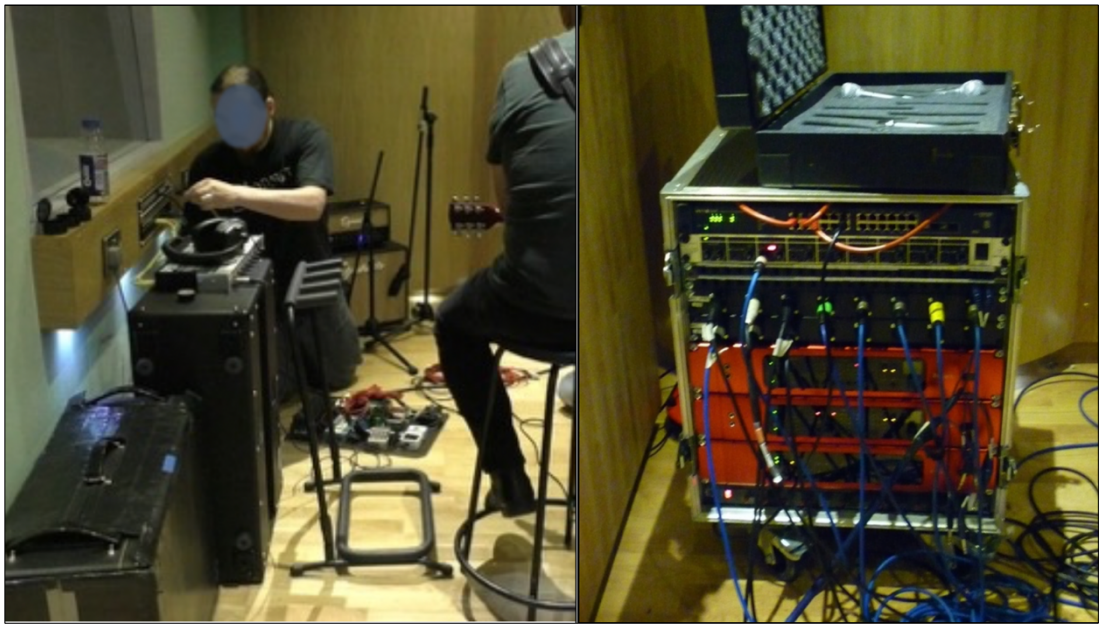


Figure 28 - Left: The recording engineer connecting microphone cables to tie lines in Wall Box Right: the RedNet interface mounted in a portable rack.

For both of these connection types, the recording engineer uses the same mapping methods to organise the audio that we have explored so far, but with some key differences in the accountability to the work that these methods display. It is more appropriate to explore this further in the following sections on methodical uses of metadata in mic'ing up (pp. 81). For now, in order to maintain the integrity of the sequence of actions: with microphones positioned and connected to the recording equipment, the members go on to test the recording configuration in a line check.

Line Checking

After mic'ing up each instrument, the recording engineer and the musicians cooperate to perform a 'line check', which is done to ensure that the instruments and recording equipment are working and to minimise potential disruption to recording activities from technical faults. This process is coordinated over the talkback system and requires the musician to play an instrument or sing to create an audio signal in the recording equipment, while the recording engineer methodically checks each part of the signal path. These checks are done both visually, using signal level meters and

indicators displayed on the equipment; and aurally using the recording console to output audio at different stages of the signal path to the monitor speakers. The engineer also checks the signal levels and adjusts them accordingly using input gain controls and level meters to ensure that the signal level is neither too high, which overloads and distorts the sound, or too low which diminishes the quality of the recorded audio.

Troubleshooting

Should problems occur in a line check, such as absent signals or abnormalities in the sound (crackling, buzzing, distortion), the engineer employs a process of checks on each part of the signal path to pinpoint the problem. An example of this is offered in the next section which provides some insight into contingent action in the production process: in brief, the recording engineer finds a work-around for faults, which are documented and made good at a later date to avoid stalling the production activities.

Shaping the Sound

While the musician is still playing or singing, the recording engineer employs some simple methods to shape the instrument's sound. The first is to use the equipment controls to balance the mix of different sources for each instrument to blend their tonal characteristics, for example the two microphones on each guitar. This technique may also include, as the recording engineer put it, adding "just a touch of EQ on the way in", or applying a subtle amount of frequency equalisation processing (EQ) to a signal before it is captured in the DAW. A second technique is to reposition microphones to either focus on capturing a dimension of the instrument's sound, for example the centre or the rim of a cymbal produce different sounds; or to simply align microphones so that their signals are in phase when blended together and so not cause any signal cancellation.

Making a Test Recording

After doing some initial shaping of the sound, the engineer makes a test recording of the musician's playing or singing, which is used as a collaborative resource to inform the further shaping of sound using methods above. For example, on playing back and listening critically to the test recordings of the guitars, the recording engineer makes small but significant alterations to the positioning of microphones to fix some phase cancellation. In the case of the rhythm guitar more drastic actions result in which the musical and recording equipment is changed significantly, in order to create a more 'vintage' sound. This begins with the addition of a vintage design microphone and then a change of guitar amplifier, for which each change which is subject to a repetition of the mic'ing up and line checking process, including the creation of new test recordings that are again drawn upon as a collaborative resource, before being deleted as a by-product of the process. Collaborations also centre on how the sounds are anticipated to complement each other, in particular the timbre and tone of the

guitars, however this concern is practically addressed later in recording stage of the process.

5.1.2 B) Uses of Metadata in Mic'ing up

Further Examples of Mapping Audio to Organise the Control Room

As seen so far, the kinds of metadata practically used in the studio are contained in inscriptions on the studio equipment that typically denote the interconnections between multi-track recording equipment. In the job of mic'ing up, these metadata are also drawn upon to map audio from its source (a microphone) to its destination (a digital audio track), via an array of other supporting and organising resources in the control room space (studio monitor speakers; headphone feeds; audio controls). Much of the initial organisation of audio controls in the control room is done 'on the fly' in the mic'ing up activity, as each source is connected up and mapped to the recording equipment. For example, the bass guitar microphones, and DI box are connected to consecutively numbered recording console channels, via the wall box, which in turn keeps the controls allocated to the bass guitar clustered together. (Figure 29).

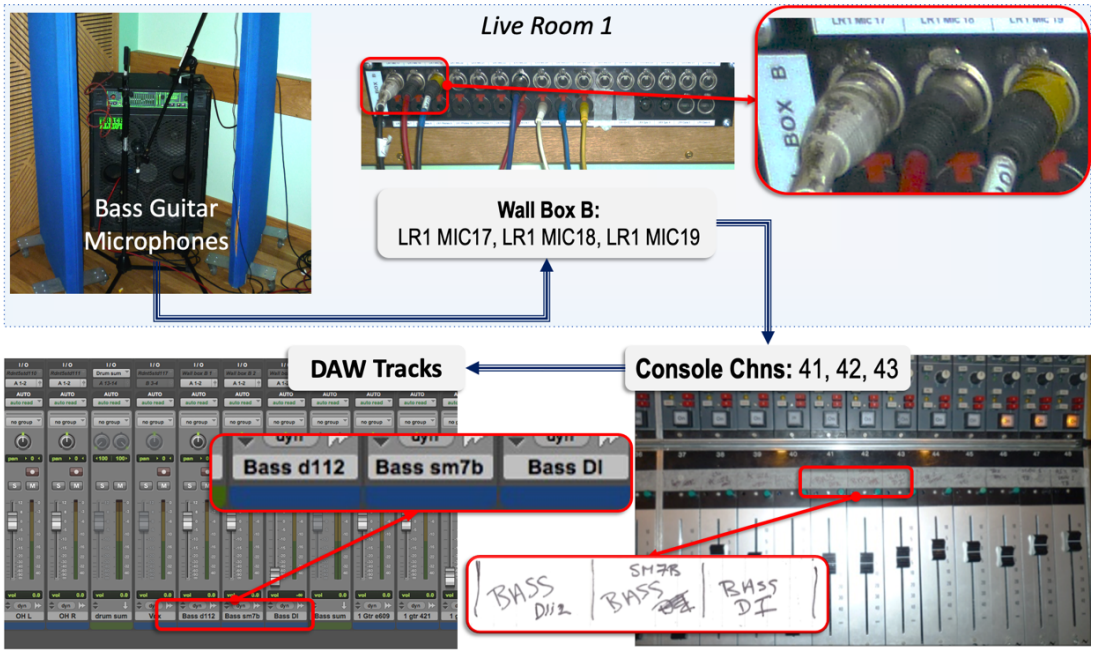


Figure 29 - An example of mapping and labelling the setup for recording bass guitar.
The signal chain clockwise from top left: microphones > wall box > console channels > DAW audio tracks.

This practice can also be observed in the recording configuration for the drums, which are connected to a RedNet digital interface that conveys multi-channel audio over ethernet directly to the DAW. Although the system handles software controlled virtual audio channels, the signal routing from physical connections to the system are fixed and so the basic method of mapping to allocate audio to a channel is still used. Here the drum microphones are mapped in an order that clusters the software controls together for different components of the sound: the two kick drum mics; the two snare

drum mics; the three ‘tom’ drums; and the overhead microphones (Figure 30). This practice of drawing on metadata to allocate audio and cluster controls for each instrument in turn provides for the subsequent line checking activities in which the ordering of controls aids their usage in testing, troubleshooting, and shaping the sound.



Figure 30 - Detail from RedNet monitoring software showing channel labels for the drums

Mapping Audio Groups, or ‘Sums’

To bring about further organisation to the control room, mapping methods are used to group audio into ‘sums’, or sub mixes, that are created in the DAW to aggregate the multiple audio sources from each instrument to a single set of audio controls. Figure 31 shows an example of the mappings used to create a sum for the bass guitar and the labelling that is draw upon and created in its configuration (also see Figure 29).

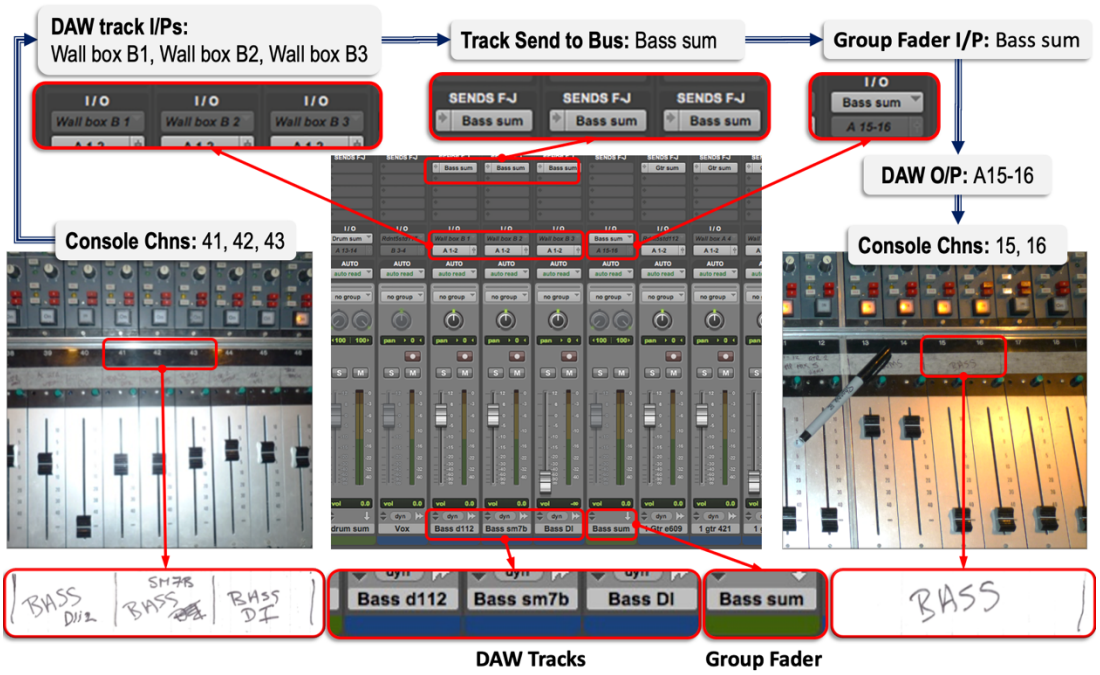


Figure 31 - An example of mappings used to create a 'sum', or sub-mix, for the bass guitar. The signal chain from left to right: the console channels handling inputs > DAW audio tracks > DAW send controls to internal busses > DAW group fader control > DAW outputs > console channels.

The sums for each instrument are allocated to channels in one section of the recording console centred on his working position to provide the recording engineer with control over the loudness of each instrument without upsetting the balance of components used to shape its sound. This in turn provides for activities in the recording stage that require the engineer to carefully monitor (listen to) and refine the overall music mix while positioned in a crucial spot in front of the studio monitor speakers (see Figure 38, pp. 98).

Further Examples of Annotating for Retrospective-Prospective Coordination.

The mappings created in the mic'ing up activity are annotated at key points on the equipment and displayed as handwritten or digital labels that both provide a retrospective account for the configuration, and prospectively provide for future activities by making audio controls navigable. In terms of retrospectively accounting for the configuration, labels might typically include shorthand information about the instrument being captured and the microphone type used; the audio source (for example, microphone type, or DI Box); the microphone positioning; and the grouping of audio. For example, Table 5 shows the configuration of mappings for recording the bass guitar and the labelling created and applied to the recording console and the DAW that records the instrument and microphone type for each source.

Table 5 - Labelling used in mic'ing up the bass guitar.

Audio Source and type	Wall box Connection Label	Console Ch. No.	Console Ch. Label	Maps to DAW I/P	DAW Track Label
Bass Guitar mic (AKG D112)	LR 1 MIC 17 (Wall box B, Live room 1)	41	"BASS D112"	Wall box B1	"Bass d112"
Bass Guitar mic (Shure SM7B)	LR 1 MIC 18 (Wall box B, Live room 1)	42	"BASS SM7B"	Wall box B2	"Bass sm7b"
Bass Guitar DI	LR 1 MIC 19 (Wall box B, Live room 1)	43	"BASS DI"	Wall box B3	"Bass DI"

This annotation format is used consistently with the recording configuration for the other two guitars, and later the acoustic guitar mic'ed up in the overdubbing stage. Labelling for the drum microphones differs, however, and instead of annotating the microphone type, a shorthand description of the position and placement of microphones on the drumkit is recorded instead (Table 6). Again, this retrospectively records the configuration of audio, and prospectively provides for the navigation of controls, particularly in the subsequent line checking activity.

Table 6 - The configuration of channels for mic'ing up the drums.

Microphone Position	Connected to RedNet Ch. No.	RedNet Ch. Label	Maps to DAW I/P	Pro Tools Track Label
Inside the kick drum	1	'Kick'	Rdnt5std11	Kick in
In front of kick drum	2	'Kick-out'	Rdnt5std12	Kick out
Above snare drum	3	'Snare-top'	Rdnt5std13	Snare top
Below snare drum	4	'Snarebtm'	Rdnt5std14	Snare bttm
Hi-hat cymbals	5	'hi-hat'	Rdnt5std15	Hi hat
Hi tom drum	6	'tom-1'	Rdnt5std16	Tom1
Mid tom drum	7	'tom-2'	Rdnt5std17	Tom2
Floor tom drum	8	'flr-tom'	Rdnt5std18	Flr tom
Ride cymbal	9	'Ride'	Rdnt5std19	Ride
Overhead Left	10	'OHL'	Rdnt5std110	OH L
Overhead Right	11	'OHR'	Rdnt5std111	OH R

Finally, the labelling of the sums differs again to succinctly indicate the content of the audio (the instrument) to prospectively provide for recording process, which again requires the navigation of recording console controls allocated to balancing the music-mix of instruments.

Table 7 – Mapping and labelling used to creating the instrument 'sums'.

DAW Bus label	DAW Group Label	DAW O/P	Maps to Console Ch Nos.	Console label
Drum Sum	Drum Sum	A 13-14	13-14	DRUMS
Bass Sum	Bass sum	A 15-16	15-16	BASS
Gtr sum	Gtr sum	B 1-2	17-18	GTR
N/A*	N/A*	B 3-4	19-20	VOX
Gtr dave	gtr dav	B 5-6	21-22	GTR DAV

***As only one microphone is required for recording vocals an audio group is not required and so is allocated directly to a DAW output.**

Metadata as an Integral Resource in Mic'ing Up

Having detailed the metadata that is used and created in doing the mic'ing up task, we now turn to real-world examples that illustrate just how metadata are integral to the accomplishment of mic'ing up. The first example is actually taken from the overdub stage of the process, as the action is captured more clearly in this field data and is performed in the same manner, with the same methodical metadata uses as mic'ing up in the setup stage. Extract 2 neatly demonstrates mapping, line checking, labelling, and troubleshooting all within a short sequence of action.

Extract 2 – Mic'ing up a guitar

The guitarist (Richard) sits on a stool in the centre of the live room playing the acoustic guitar while the recording engineer (Paul) positions two microphones in front of him to record the guitar. Paul then connects the microphones to the tie-lines in 'Wall box A' labelled 'LR 1 MIC 14' and 'LR 1 MIC 15', which map to channels 38-39 on the upper half of the recording console (incoming audio channels start at channel 25 and so channel numbers are offset by 24).

Paul: [Enters the control room, picks up a marker pen near DAW; walks over to the right half of the recording console; counts channels on upper half of console]

Paul: Nine, ten, eleven, twelve, thirteen… …fourteen (.) is it thirteen-fourteen? (I'm) sure I did… [Writes on the labelling strip to label channels 37-38 as 'AC GTR', 'AC GTR U87']

Paul: It's got to be that one. [Checks the input level meters on the console and realises he has labelled the wrong channels; Amends labelling on channels 37-38 as 'AC GTR', 'Rib AC GTR U87'; labels channel 39 as 'AC GTR U87'].

Paul: [begins sound checking acoustic guitar while Richard (guitarist) plays: switches on ch. 39, the guitar can be heard, reduces the channel gain; switches off ch. 39; switches on ch. 38, increases the channel gain]

Paul: Fourteen and fifteen, you silly sod!
[returns to DAW; maps inputs labelled 'Wall box A14' and 'Wall box A15' to 'Ac gtr 1' and 'Ac gtr 2' tracks respectively; continues adjusting gain on ch's 38-39; returns to DAW amends track names to 'Ac gtr 1 rib' and 'Ac gtr 2 u87'.



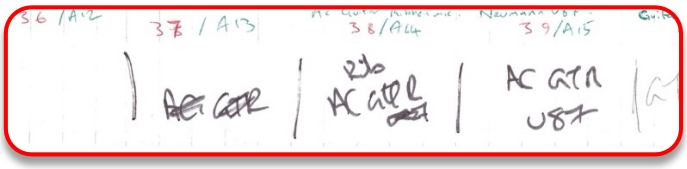


Figure 32 - Labels on the DAW tracks (top) and the recording console channels (bottom). Note: the annotations in red/green are not the recording engineers and have been made in the analysis

What the extract above shows us is that the mic'ing up activity is not constituted of a sequence of discrete activities, as we might assume from the glossed descriptions above, but a continuous and iterative process in which the use and creation of metadata is integral. Also, that these activities can be fraught with minor troubles as the engineer has to memorise mappings between actions, which in this case resulted in annotation errors and subsequent corrective action. However, as we shall see next, erroneous annotations can in some cases be of utility to the process.

Extract 3 - Troubleshooting

The rhythm guitarist (Richard) and the recording engineer (Paul) have begun to perform a line check on the rhythm guitar recording setup. While Richard is playing to ensure a signal is present, Paul comes across a fault in the line of the signal path.

Paul: [Switches on first guitar mic channel; switches off talkback; a crackling sound can be heard; plays with input switches and controls] I think we've got some dirt in the switches [Continues to play with channel switches]

Paul: Sounds shit! [leaves the control room and enters the live room; maps the microphone to a different channel on the wall box; Returns to the control room]

Richard: [Guitar playing continues]

Paul: [Switches on newly assigned console channel so that the guitar can be heard; reallocates the track input in the DAW; picks up the marker pen and writes on the channel labelling strip to re-label the channels (Figure 33); continues switching between the guitar channels and listening as the guitarist plays]

Following from this, the recording engineer comes across the same problem in two more recording console channels, each time repeating the same methodical process of mapping, line checking and labelling until the second microphone is eventually connected to a RedNet interface to bypass the recording console altogether (see also Figure 30 pp. 82).

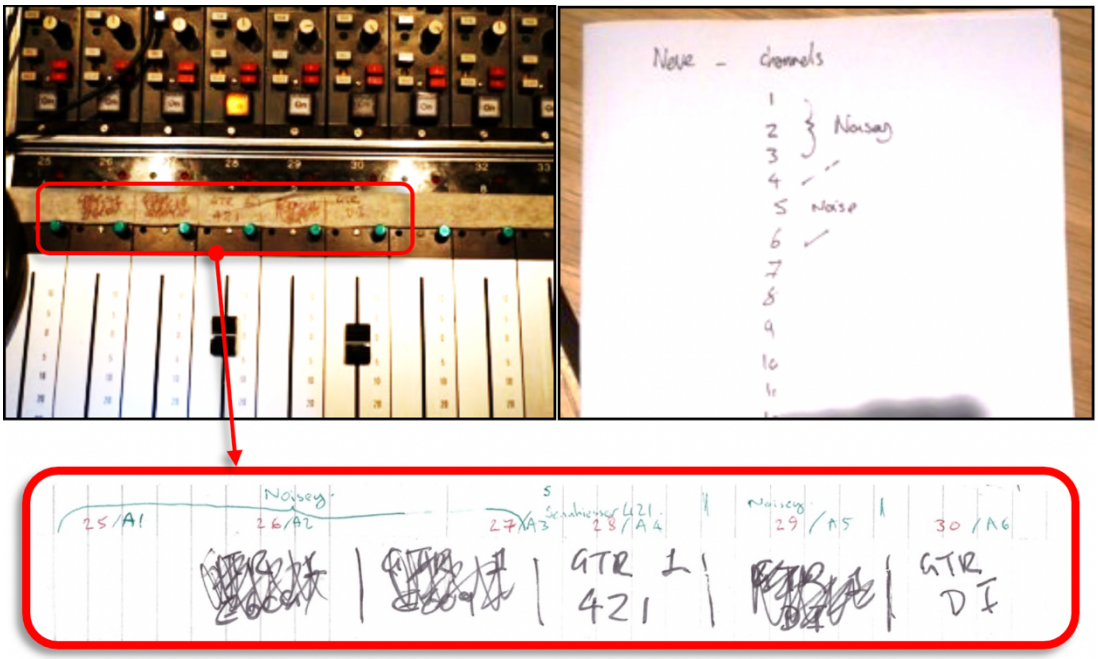


Figure 33 – Top: labels scribbled out on bypassed channels resulting from fault finding. Botton: A record of channel faults copied from the labels.

This example demonstrates the kinds of contingent action and the ad hoc formulation of workarounds when troubles occur in the process and further still the role of metadata in the job of troubleshooting. A notable by-product from this example of trouble shooting is how the recording engineer scribbles over labels to denote faulty channels: firstly, as an indicator to *'do not use'* in any other mic'ing up activities; and secondly, as a temporary record of faults, which the recording engineer later documents on paper to be used in planning maintenance after the recording session (Figure 33).

The next example demonstrates the methodical uses of test recordings, which are tentatively included in this section, not as a form of metadata, but as a processual resource that bears a resemblance to metadata. In the extract below, the test recording enables the singer to hear for himself how the recordings of his performance will sound and engage in a critical evaluation of the vocal microphone tonal quality with the recording engineer.

Extract 4 - Doing a test recording

The singer (Chris) is in live room 2 while the recording engineer (Paul) is in the control room performing a line check of the vocal mic: while Chris sings into the mic, Paul checks the signal paths then creates a test recording:

Paul:	[Rolls on chair to workstation; Taps a keyboard shortcut to start DAW recording; rolls on chair to working position and listens for twelve seconds].
Chris:	(Stops singing)
Paul:	(Into TB mic) You know what, I'm happy, do you want to come and have a listen?
Chris:	(Through Monitor Speakers) OK.
Paul:	[Rolls on chair to PC workstation; taps keyboard space bar to stop DAW recording; positions DAW timeline marker to beginning of test recording; puts studio TB mic down; taps the keyboard space bar to start playback of the test recording.]
Chris:	[Walks back into control room stands to the right of the working position.]
Paul:	[Rolls on chair to listening position.]
Both:	[Remain still while listening to playback]
Chris:	(Playback ends) Yeah, OK.
Paul:	[Taps the keyboard space bar to stop playback] s'alright that mic.
Chris:	Yeah, its very nice… … its basically… ..yeah.
Paul:	It's a bit more forgiving than a condenser because it…
Chris:	I was just going to say yeah…
Paul:	It doesn't take… it takes that little bit of the higher end…
Chris:	correct yeah .
Paul:	You don't want that…
Chris:	I don't want high end, no exactly. That's right that's what i've always thought when I'm singing into a condenser it's always a bit too kind of bright… and erm … especially with rock music you don't want it too kind of, up there.

The test recording yields a satisfactory result: the members agree the microphone tone is suitable for the musical style compared to their experience of other microphone types (condenser microphones).

The test recording is created and used as a resource for the line checking activity, after which it is discarded as a by-product of the process. It is this *methodical use* and its *retrospective-prospective* property to both represent the configuration and to provide the checks needed for future steps of the process that arguably characterises test

recordings with metadata-like properties that have hitherto been identify in this analysis. This conclusion might well be pushing the boundaries of classification, however the prospect of metadata in multi-modal forms are explored elsewhere in these studies and in the discussion and so for now we will treat test recordings as an *expendable processual resource* that bears a resemblance to metadata

5.1.3 Finishing Up

Once all of the instruments are positioned and mic'ed up, the recording engineer attends to finalising the setup. This is not a substantial part of the setup stage and so this section is relatively brief, combining the description of the jobs with the descriptions of the metadata involved.

Housekeeping

In this task, the recording engineer attends to tidying up the recording studio space and, crucially, checking the equipment for any misconfigured or incomplete audio mappings, and missing labelling. As we have seen so far, production metadata are integral to mapping and labelling audio which is done 'in and amongst' the job at hand, rather than as a discrete task. This can result in labelling being incomplete or overlooked and so attending to housekeeping in this way ensures that the configuration is complete, a task which eventually culminates in the second of the finishing up tasks.

Templating the Configuration

In order to preserve the configuration of mappings and labelling, the recording engineer creates a DAW project file, which is crucial resource used in the recording stage of the production. The DAW project file acts as a template which the recording engineer uses to create new project files instantly that are ready to capture each song with all the correct audio mappings, groupings, display order, and labelling of tracks that match up with the physical labelling kept in situ on the recording console. This ensures that the digital metadata, at least, propagates through the process consistently and the multi-track audio data generated in the recording process is labelled up correctly. Examples of the template in use are detailed in the reported observations of the recording stage, and so we may conclude the description of the setup work and its methodical uses of metadata in the following summary.

5.1.4 Summary of the Setup Stage

The setup stage of the recording session provides the contingencies, resources, and organisation for all other stages that proceed it. To recap, the work of setting up is underpinned by practical reasoning about the configuration of space; the coordination of recording activities; the production and assembly of the songs; and how process is modelled to accommodate the recording requirements. This setup work turns upon a number of key activities:

Situating musicians, instruments, and equipment - involves a compromise between the configuration of space for coordinating performances, and the separation of sound required for multi-track recording. Methods include containing sound with acoustic panels; and isolating the singer from the band using a 'foldback' system of headphones and talkback microphones to communicate and coordinate activities between rooms.

Mic'ing up - involves using a configuration of different microphones types and placements appropriate for each instrument and connecting and mapping them to the recording equipment in an organised manner. The members perform a 'line check' is to test and troubleshoot the equipment and to shape the overall sound of each instrument in turn using mic positioning and mixing methods.

Finishing up - concludes the setup stage in which the recording engineer creates a DAW template file so that a correctly configured song files can be created instantaneously in the recording stage of the session. Preserving the situated structure, organisation and information about the situated configuration of audio information exemplifies the methodical uses of 'production metadata'.

About the Metadata

The analysis identifies these metadata, *firstly* as the inscriptions on the studio apparatus that contain generic information about the predetermined configuration of interconnections between recording equipment. These metadata accountably embody the work of the studio setting as they are intended to be drawn upon methodically to map audio to the situated organisation of people, recording equipment, and space; for example, mapping headphone feeds to connections closest to the musician's performance space, or the order and allocation of audio sources to audio channels in the control room. *Secondly*, metadata are created through the recording engineer's annotations of the situated configuration, which are displayed in the physical and digital labelling applied to the equipment. These metadata provide a 'retrospective-prospective' resource in the coordination of production activities: *retrospectively* they document information about the situated recording techniques for each instrument (for example, microphone type and positioning), or the organisation and grouping of audio; while *prospectively* providing for its anticipated uses, which as we see next includes supporting the navigation of the huge array of controls in the control room in the recording stage.

5.2 RECORDING

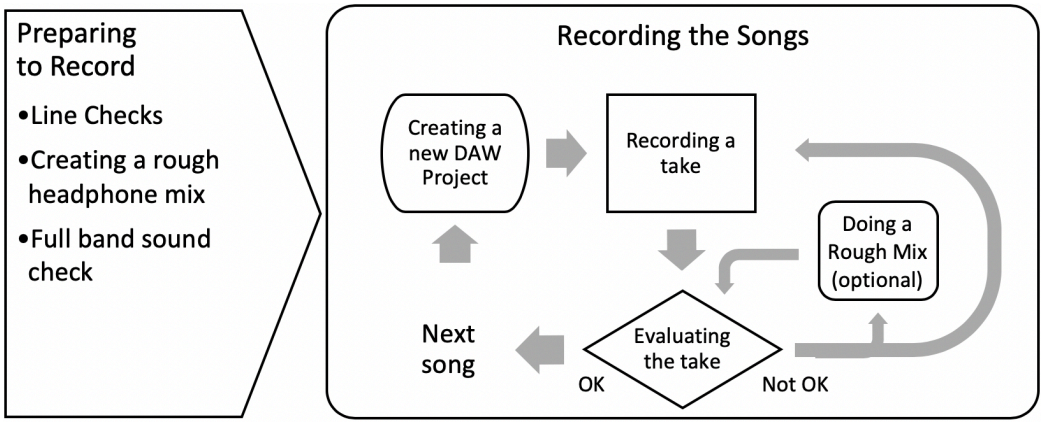


Figure 34 - The Flow of Recording Activities

In the recording stage of the process, the recording engineer and the musicians coordinate to capture real-time song performances, using the recording equipment configured in the setup stage. Seven songs in total were recorded in this stage of the production and this section describes three key activities in this stage, as summarised in Figure 34 and below:

- *Preparing to record* – involves doing further line checks with individual band members and the whole band in ensemble, in order to test the recording equipment, and to orient the musicians to the performance situation including customising their foldback mixes.
- *Recording the songs* – involves a process of *recording 'takes'* of the band's real-time ensemble songs performances, in full, or in part, from which the records are eventually produced. The members collaboratively *evaluate the take* for performance quality, and optionally *doing a 'rough mix'* of the song to evaluate the sound. The cycle of activity draws upon the resources created in the setup stage, including using the DAW template to *create a project file* for each new song.

5.2.1 A) Preparing to Record

Preparing to record comprises a number of tasks in which the members cooperate to check that the musical and recording equipment is working, including the foldback system, and to orient the musicians to the situation and warm up for performance. Briefly these tasks are:

- *Line checks* – to test each instrument and its associated recording equipment.
- *Creating a rough headphone mix* – to suit each musicians' performance requirements.
- *Full band sound check* – to warm-up the band for performance and refine the headphone mixes.

Line Checks

To begin the recording activities, the recording engineer coordinates with each of the musicians individually to line check their instrument and associated recording equipment. This is largely a repeat of the line checking done in the setup stage, however, in this stage of the process there are certain differences in the practical reasoning. The recording engineer's primary concern remains, to check the recording equipment is working and that all parts of the signal chain are fault free, however the concern for shaping sound is suspended in order to expedite the recording activities. Any test recordings made are used only as a resource to demonstrate to the musician how their recorded performances will sound, not as a resource for shaping sound, and are deleted immediately after use.

Creating a Rough Headphone Mix

Following on from the line checking activity, the recording engineer and musician collaborate to create an approximate mix of audio for the musician's headphone feed. This is done through discussion of the musician's performance preferences during which the recording engineer adjusts volume levels for each instrument in the mix accordingly. For example, the drummer expressed a need to hear the bass guitar prominently in the mix as his performances tend to follow the bassline of the song. Again, this contributes to orienting and settling the musicians into the performance setting and provides a starting point for the following activity involving all the musicians together to refine the headphone mixes.

Full Band Sound Check

Following the individual line checks, all of the musicians are called to take their positions in the studio ready to perform. Before any song recording commences, however, all the members do a 'sound check', which involves the musicians performing a familiar song to test the equipment and make some final refinements to the configuration. The concerns in this activity are *firstly* to allow the musicians settle in and 'warm up' ready for performance, including testing out and altering their

headphone mixes in cooperation with the recording engineer. *Secondly* the sound check also allows the recording engineer to hear all of the sound sources in the music mix and make adjustments, including refining individual sounds in contribution to the overall mix. To conclude the sound check, the recording engineer updates the template file in the DAW to preserve changes to the headphone mixes, so that they may be instantaneously recalled in the following recording activities.

5.2.1 B) Uses of Metadata in Preparing to Record

In the previous part of this chapter, we explored the metadata created in the setup stage through the recording engineer's annotation practices displayed in textual labelling of the recording configuration. The analysis positions the role of these metadata as prospectively providing for its anticipated uses in the recording process. The following example demonstrates this in the recording engineer's use of his own annotations to navigate audio controls in the sound check activity that is done directly before song recording starts.

Navigating Audio Controls

In Extract 5 below, the members do a sound check to address the concerns described above. This process involves the band members partially performing a song that they are familiar with then collaborating with the engineer to make adjustments to their headphone mix before repeating the process again until all band members are satisfied with the situation conditions and are ready to have their proper performances captured. Simultaneous to this the engineer begins to use the recording equipment to refine the sound and balance of instruments in the overall music mix.

Extract 5 - Sound Check

Having completed the individual line checks, the members move the process on to do a sound check of the whole band performing a familiar song (Can't Get Enough of Your Love by Free). The band are in position in the live rooms ready to perform wearing their headphones, while the recording engineer (Paul) is in the control room. The band members Richard (guitarist), Chris (Singer), Dave (guitarist), Alan (Bassist), and Simon (Drums) coordinate by conversing over the talkback system, this account is heard from the control room.

Richard: Right, Can't Get Enough you ready? (counts the band in) one – two – one-two-three-four…
//The band perform Can't Get Enough of Your Love by Free//

Paul: [Rolls on chair to right side of the recording console; listens and applies some EQ adjustments to channels in the range 41-45 ('BASS D112', SM7B Bass', 'BASS DI', 'GTR2 SM57', 'GTR2 421'); Rolls on chair to left side of the recording console; slightly adjusts balance of instruments using the faders in channel range 13-22; Rolls back to right side of the console and makes further adjustments.]

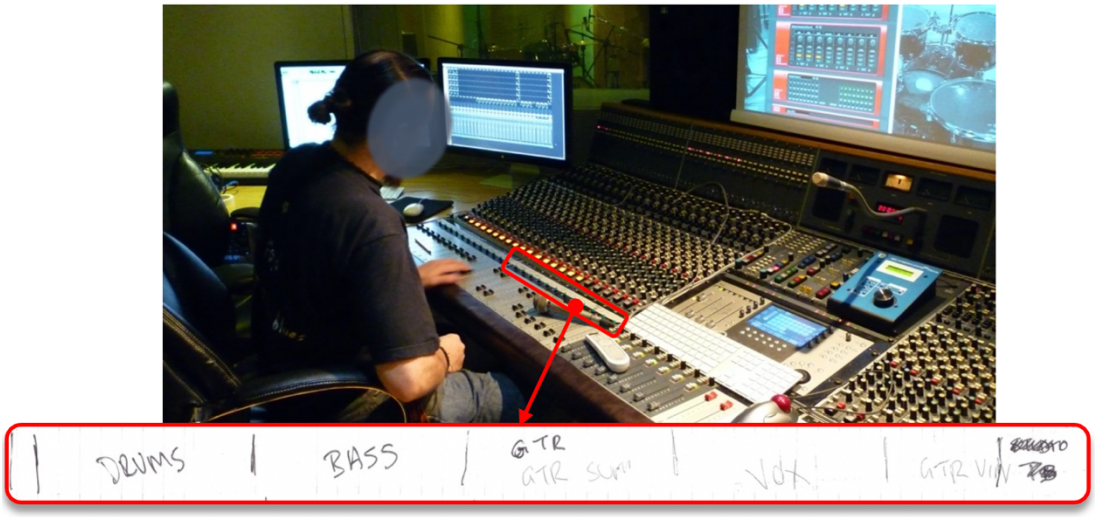


Figure 35 - The Recording engineer navigating and using the recording console controls

Band: [Stop performing midway through the first verse.]
Dave: (inaudible)
Richard: OK well…
Paul: [Rolls chair to the PC Workstation, picks up TB mic] Who said they can hear too much bass?

//Transcript abridged//

Dave: I can't hear much of this (*points to his guitar)*.
Paul: OK one second [adjusts Dave's headphone mix using the DAW controls (Figure 36)

//Transcript abridged//



Figure 36 - The recording engineer using labelling in the DAW (pseudonymised) to locate the correct send control for adjusting the singer's headphone mix.

Richard: I think there's too much bass in all the headphones.
Chris: (In Live Room 2) Yeah I'd agree with that.
Paul: No problem [continues working on the headphone mixes in the DAW]
Alan: Oi Chris, get back in goal!
Chris: (Laughs)
Alan: Paul, can I have more bass in mine please? Seriously.
Paul: Yeah yeah; [continues working on the headphone mixes in the DAW].
Alan: I can't hear it, they've got all mine.
//The musicians play a few notes on the guitars to check the adjusted level in their headphones.//
Paul: Right if you want to go again…

This extract demonstrates real-world methodical use of metadata for navigating controls in the recording process, which is a critical feature of the metadata's accountability to the work. The ability to navigate the recording equipment controls is essential considering the complexity of the recording configuration. Note, in the short space of the extract above, the recording engineer attends to *three* separate sets of controls: *firstly*, the recording console controls for handling the microphone inputs (labelled: 'BASS D112', SM7B Bass', 'BASS DI', 'GTR2 SM57', 'GTR2 421'); *secondly*, the 'sums' or sub-mixes of the instruments for balancing the overall music mix (Figure 35); and *thirdly*, the virtual controls in the DAW allocated to managing the headphone feeds (Figure 36). Finally, as previously described, the recording engineer updates the DAW template produced in the setup stage, in order to preserve the headphone mix settings created in the sound check. This action, preserving information that is accountable to the work, is a piece of metadata-work that also provides for the following song recording activities, as we will explore next.

5.2.2 A) Recording Songs

With the recording preparations complete and the musicians, equipment, and engineer primed to capture performances, the song recording activities commence, which involve:

- *Creating a new DAW project* – Using the template created in the setup and preparation, the recording engineer is able to generate a new properly configured song file for each new song.
- *Recording takes* – The members coordinate to capture the bands performances to multi-track audio.
- *Evaluating takes* – The members collaborate to critique the performances and decide whether they are adequate or whether to fully or partially re-record a song.
- *Doing a Rough Mix* – The recorded song may, optionally, be roughly mixed to give an approximate representation of the final product, in order to enable a more considered evaluation.

Creating a new DAW project

The template created in setup provides the recording engineer with the contingency to quickly create new project files that are situationally configured ready to capture songs. This resource is used repeatedly throughout the process in response to the band's decisions to record new songs as the recording session progresses, and also ensures that audio and compositional data generated in the process are stored to hard disk in an organised manner (in this case by song title).

Recording a Take

Recording 'takes' of the song performances is a procedure that requires the recording engineer to coordinate the action, for example, ensuring that the recording equipment is recording before communicating this to the musicians to prompt the beginning of their performance. During the performances, the recording engineer *monitors* audio from the control room for two main concerns.

- *Firstly*, the standard of performance, which includes any significant mistakes and the qualities of the musical delivery, for example, was it appropriately lively or emotive;
- *Secondly*, any technical problems with the audio such as signal clipping (overloading), faults, or excessive spill.

In terms of monitoring quality of performance, the engineer's evaluations contribute to decisions surrounding the recording of multiple takes of a song, which is detailed in the next section.

Evaluating Takes

After each take, members flag up any significant issues with the performance quality in a collaborative process of feedback and critique that informs subsequent production decisions. The engineer's perspective is particularly important in these collaborations, as what is heard in the control room is more detailed than what musicians hear through headphone mixes and is more representative of what the finished recording will sound like. Feedback can result in a number of processual outcomes; members may decide to record another take of the song; reject the song altogether; keep the recording and move to the next song.

Doing a Rough Mix

The engineer is occasionally required to create a 'rough mix', to better inform the evaluation of the recordings. This is a quick mix of the multi-track audio without the refined editing processing and treatments applied in post-production. Multi-track audio in its raw state seldom represents the final product, and so the rough mix provides a resource that is close to this that members can draw upon to extend and broaden critical listening and feedback and to inform production decisions.

5.2.2 B) Uses of Metadata in Recording

Prospectively Organising Audio Data

DAW project files as a processual resource can be considered a form of metadata. As well as supporting the vast array of DAW functionality, they capably encapsulate the compositions of audio data that make up a song; the configuration of audio signal paths internally via virtual audio elements, and externally via interfacing hardware; and the labelling and annotations applied to audio elements and data in the DAW environment. In the methodical uses of the DAW file, the recording engineer exploits these affordances to provide a contingent resource for the recording stage that supports the recording process and organises the audio data generated in the process, as demonstrated in the following extract.

Extract 6 - Creating a new DAW project

The band are filtering past the control room to the live rooms after a break from recording and are ready to record their next song. The recording engineer (Paul) interrupts the guitarist's (Richard) conversations to find out the name of the next song to be recorded.

Richard:	It's Sharp Dressed Man
Paul:	Sharp Dressed Man, right… (inaudible); [re-enters the control room and sits in front of the DAW workstation, closes the previous recording; opens a new DAW 'session' (song file) from a template and names it 'Sharpe dressed man' (sic)].
Paul:	Tell you one thing I'm glad I created all these templates yesterday. Don't half make this so much easier. 'specially like this cos it means I can… …all the sessions (song files and audio data) are grouped together now as well so I've not got like… …hundreds and hundreds of audio files all over the place [selects all tracks and sets them to record mode]
	//Transcript abridged//
Paul:	[Taps Enter on the PC keyboard to start DAW recording; looks up again to see if band are ready; the band are heard warming through the studio monitors; waits for the warming up to settle down, picks up Studio TB mic]
Paul:	(Into TB mic) Are we all ready?
	(Inaudible reply from Live Room through TB)
Paul:	I'm rolling so whenever you're ready, Go for it.
	(Inaudible discussion can be heard through TB, some more warming up on instruments is heard in studio monitors)
Richard:	Ready, 1 – 2 – 3 – 4…
	(The band perform Sharp Dressed Man by ZZ Top)

This extract demonstrates the flexibility that the DAW template provides in responding to ad hoc decisions made in the process. Creating 'sessions', or song files, for each new song provides a blank container to capture multi-track audio that is correctly labelled and organised; and situationally configured to be available to other resources, for example the headphone feeds. Further, the labelling propagates through the process as the DAW applies track names to each audio track, as can be seen in Figure 37, which in turn prospectively provides for future stages of production, including the overdubbing, detailed in the section 5.3, and the mixing stage (not included in this study).

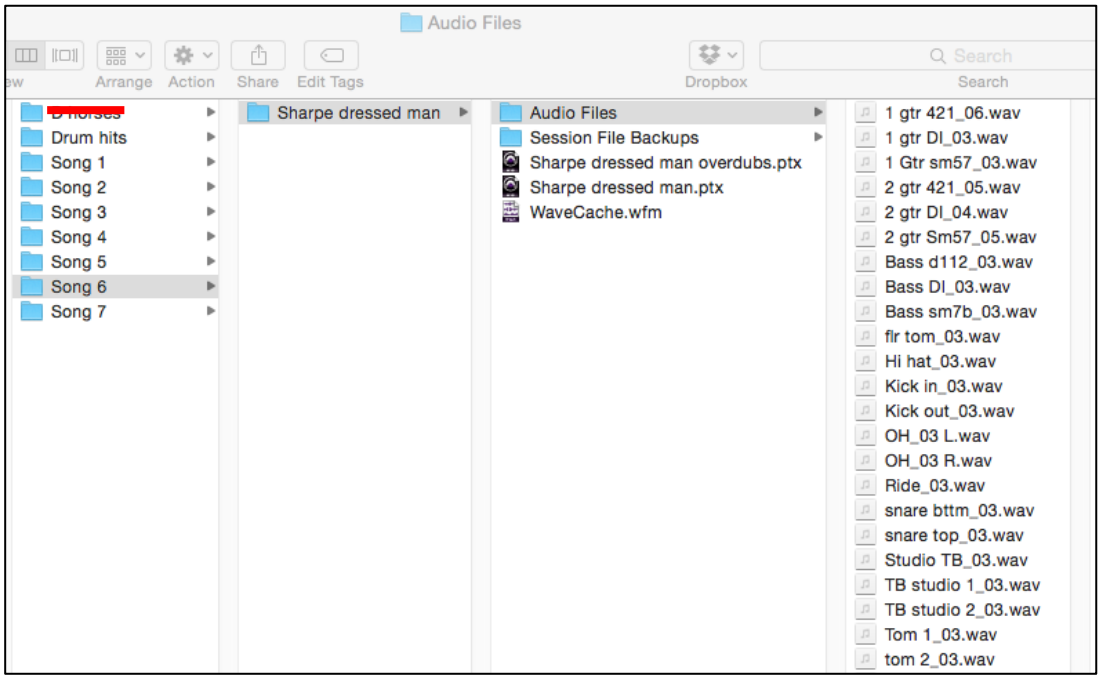


Figure 37 - Folder and file structure for songs recorded in the session (the session appended 'overdubs' was created later). The top level structure was created by the Recording Engineer.
Note: the file names for the *.wav audio files are generated from the track labels in the DAW.

Providing for the Monitoring and Evaluation of Performances

As described on page 95, the recording engineer's practices in this stage of the production includes 'monitoring' the recording of the band's performances, in order to be vigilant for technical concerns and provide a critical evaluation of the musicality each take. Monitoring methods however are difficult to convey entirely through vignettes extracted from the video data: action in the control room is devoid of insightful dialogue during recording, as monitoring requires an aural focus that precludes talk (including field researcher's inquiries); and the recording engineer's actions, of which there are very few, are centred on audio controls that are difficult to capture in detail. By way of explication then, we shall:

- *Firstly*, explore the accountability of the spatial organisation of the control room to monitoring work, as prospectively brought about through metadata used in the setup stage.
- *Secondly*, use an example of dialogue captured *between* takes in which members collaboratively evaluate the performances, which are captured from talkback and embedded in the song data as *voice annotations*.

Drawing on the Organisation of the Control Room

Much of the setup work that provides for the recording stage centres around organising what the recording engineer calls his 'working position' in the control room, which places him in an optimal listening position in front of the studio *monitor speakers*, in line of sight with the *live room windows*, and within reach of strategic audio controls.

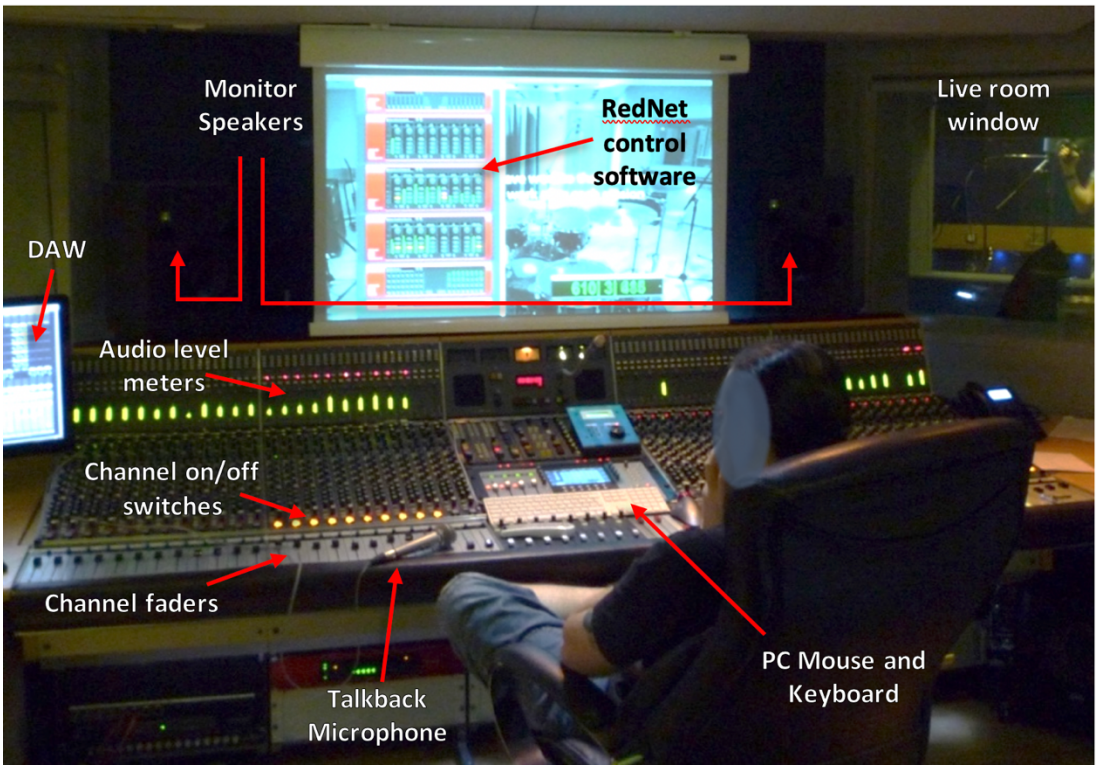


Figure 38 - The recording engineer in his working position listening to a take in real-time.

Figure 38 shows the recording engineer monitoring the band's performance of a take and illustrates the arrangement of resources used to address three main concerns in doing monitoring:

- *Balancing the music mix* – this is a continuous concern in which the recording engineer makes small adjustments to the volume of each instrument in the mix using the *channel faders* allocated to instrument sums, or sub-mixes. These channels are indicated in the figure above by the lit *channel on/off switches,* that have been mapped in the setup stage to be within easy reach of the listening position and labelled to be navigable for just this task. The engineer might typically refine the mix for every song, as the musical dynamics between instruments changes (their relative presence in the song) to match the musical composition.
- *Checking sound sources* – this a concern in the initial stages of recording as the recording engineer continues to check individual sound sources for problems such as overloading the signal, which is addressed using the channel level meters and channel gain controls to make small adjustments to signal levels. Again, this requires labelling to navigate the controls and the use of the *channel on/off*

switches to select what audio channels will be heard in the monitor speakers. This concern is eventually suspended once some final refinements to the configuration are made in the early period of the recording stage.

- *Providing feedback* – this involves collaborative conversations to evaluate each take and attend to any artistic concerns. This is done over the *talkback*, which gives the affordance to allow all members to remain in situ and so react to any resulting decisions quickly, for example to perform another take.

Generating Voice Annotations

A further affordance of using talkback to evaluate each take, is that the voice audio can be recorded and so any production decisions made in conversation between takes are captured alongside the song data. These voice annotations can be a useful source of information for engineers, as an alternative to textual notes, to inform the editing process as demonstrated in Extract 7 below.

Extract 7 – Evaluating a take

The band are in situ performing Sharp Dressed Man by ZZ Top in the live rooms, while the recording engineer (Paul) is monitoring from the control room. Dialogue is heard over the talkback mirophones between Richard (guitarist), Chris (Singer), and Paul.

//A mistake is made in the first guitar solo//

Richard:	Sorry! Ready, straight in…
Paul:	[Into TB mic] Whoa! One second, just watch your speed a bit, it was starting to race a little bit in that song [puts TB mic down]
Richard:	(partly inaudible can be heard giving musical directions to the drummer.)
Chris:	(in response to directions) Yeah big start… big start…
Chris:	Paul…
Paul:	[places hand on TB mic in anticipation]
Chris:	…can you just bring me up a touch?
Paul:	[Rolls chair to PC; adjusts the singer's headphone mix in DAW]
Chris:	TWO… That's bet… that's cool.
Paul:	[rolls chair back to listening position in front of console; waits for band discussions to conclude]
Richard:	(counting-in the band performance) One – two – three – four…

//The band play another take of Sharp Dressed Man.//

//Three mistakes are made in the second guitar solo, the band play to the end of the song//

//The band discuss the mistakes and attempt two more takes of the guitar solo section of the song only until an error-free take is recorded//

Richard:	I think that one was alright, wasn't it?
Paul:	Yeah, I think what I'll probably end up doing is take the last chunk of the solo that's good, but put it into the previous take that was, where there was a bum note, because the ending of the first take of the first (inaudible) was better.
Richard:	OK
Paul:	But yeah, but I've got to basically fix that
Richard:	OK
Paul:	if you know…
Richard:	yeah yeah, I'm OK with that then yeah.
Paul:	[Rolls the chair over to the PT workstation, stops the recording, saves and closes the session.]

This example shows, firstly, the recording engineer's role in monitoring and providing feedback, informing the band that the tempo of the song was unintentionally accelerating, or commenting on which take was performed better. Secondly, the kinds

of editing decisions that might result from careful critical listening, in this case piecing together partial takes to "fix" the mistakes in the editing process, which are most importantly recorded as voice annotation.

Providing Contingency (Doing the rough mix)

As we have seen so far, the methodical uses of metadata in the recording configuration include providing for future steps in the process. For example, the labels applied to audio tracks in the DAW propagate through the process as the recorded audio inherits these as file names in the automated organisation of the song data, which in turn provides for the its archiving and reuse in the editing and mixing stages done after the recording session. In the event that the recording engineer was required to do a rough mix of a song this organisation, intended for processes beyond the recording studio, provided sufficient contingency to be called upon immediately, as shown in Extract 8 below.

Extract 8 - Doing the rough mix

After recording their first song, Richard (guitarist), requests to hear the recording. He and the rest of the band Chris,Dave, Alan, and Simon join the recording engineer (Paul) in the control room who plays back the recording for the band. Richard is asked for his feedback, which prompts a heated discussion (abridged here) that leads to Paul doing a rough mix.

Richard: I-I think it sounded, like, dull.

Chris: Yeah but… uhh …we've been here before though Richard… …It won't sound like that when we've mixed it properly… … and nothing's really mixed properly until we get out of here, so.

…

Richard: Yeah but we should have an idea of what it's going to sound like and at the moment, I-I can't get anything out of that, that exci(tes) except Alan's bass, I think that sounds great, the solo's good…

Paul: (talks over Rich) Gimme… right… what I suggest is… erm (pause) give me ten, fifteen minutes to do a mix, to do a quick mix of it and see what you think then. Because at the moment all the faders are flat (gestures faders in a straight row with forearm)… …. if you err… grab a cup of tea.

//The musicians filter out of the control room. Does the rough mix as follows//

…

1. [Switches off instrument sums channels 13-22 on the recording console; sits at the PC workstation; switches on channels 1-2 on the recording console]

   //Instruments sums are now bypassed and only the direct mix from the DAW can be heard in the studio monitors//
2. [Sets DAW playback to start from the intro of the final take]
3. [Solos all drum tracks and balances the several sound levels using the faders]
4. [Solos two bass guitar tracks and balances the sound alongside the drums using the faders]
5. [Solos both guitar1 mic tracks and balances the sound levels against the drums and bass using faders.]
6. [Taps the keyboard space bar twice to stop and restart playback starts from the same point in the song
7. [Listens briefly to the balance of drums, bass, and guitar 1 in the intro section of the song, stops playback using the keyboard space bar.]
8. [Starts playback using the keyboard space bar, then uses the mouse pointer to skip the timeline marker to a part of the song with vocals]
9. [Solos the vocal track and increases volume]
10. [Solos both guitar 2 mic tracks and balances the sound levels against the drums, bass, guitar 1, and vocals using faders.]

11. [Uses the stereo pan control on both guitar 1 microphone tracks (1 Gtr sm57, 1 gtr 421) to pan left]
12. [Uses the stereo pan control on both guitar 2 microphone tracks (2 gtr sm57, 2 gtr 421) to pan right]
13. [Uses stereo pan control to pan 'hi-hat', 'tom 2', 'flr tom', and 'Ride' tracks to the right]
14. [Uses stereo pan control to pan 'tom 1' to the left.]
15. [Uses track fader to increase the level of the 'Bass sm7b' track]
16. [Stops playback, sets timeline marker to beginning of the take, then starts playback.]
    …
17. [Deselects Solo so that all tracks can be heard. Listens (20 seconds)]
18. [Makes some fine adjustments (undetermined) to balance the sounds]
19. [Rolls on chair to listening positions and listens (3 seconds)]
20. [Rolls on chair to PC workstation, makes more fine adjustment (undetermined) to balance the sounds.]
21. [Rolls on chair to listening position and listens (3 seconds)]

Paul: That sounds… [[presses keyboard spacebar to stop playback]] …alright for balancing some levels, obviously there's no EQ or compression whatsoever in there but… [[presses keyboard spacebar to start playback]]



Figure 39 - Doing the rough mix. This activity brings the edit window into play (left) to select sections of audio to playback. The mix window (right) is used to balance sound levels. The two active recording conole channels (lit up) are allocated to the DAW main mix, which bypasses the submixes for each instrument

To do the rough mix then, the engineer reverts to using the mixing tools in the DAW, rather than using the instrument sub-mixes routed to the console, in order to do more refined balancing of the multi-track audio. Bypassing the sub-mixes and switching to only using the main mix output from the DAW, each instrument is introduced to the mix in turn and its constituent audio tracks are balanced and panned in the stereo field, although some tracks recorded for contingency are typically left out of the mix. The full mix of the song is then subjected to refined adjustments to levels and panning of individual elements.

What this example demonstrates is the contingencies built into the configuration that provide for a different orientation to the work: mixing the song. Again, this requires

drawing on labelling and organisation of audio to navigate controls and methodically balance sounds to shape the overall music mix and while this task might not have been anticipated as being required in the recording session, it was anticipated nonetheless, albeit in a much later stage of the process. The results of this contingent action provide the members with a representation of what the final product sounds like and is used as a collaborative resource to inform production decisions (on listening back to the rough mix and discussing with the recording engineer, the rhythm guitarist was satisfied and the session carried on as planned).

5.2.3 Summary of the Recording Stage

In the recording stage of the studio session, the contingencies of the configuration created during the setup stage are brought into play. To begin, the engineer and the musicians prepare to record, an activity which includes line checking with individual musicians to ensure that the equipment is working and to setup an arbitrary foldback mix; and sound checking with the band to warm up the musicians and to check and adjust foldback mixes. With checks in place and the musicians familiarised with the studio the band and the musician commence with recording songs. This process involves the coordination of the engineer and the band to nominate a song, for which the engineer creates a new DAW project from the template and makes the recording equipment ready. As song performances are recorded in real time the engineer monitors the performances and contributes to the band's critique to inform on-the-fly production decisions, for example recording another take of the song, or optionally create a rough mix of a captured performance to subject the recordings to a more detailed evaluation.

About the Metadata

Again, the uses of metadata in this stage includes drawing upon the labelling to navigate controls to make fine adjustments to the mix of instrument audio and headphone mixes in the recording preparations. The metadata work encapsulated in the DAW template is also drawn upon during this stage to create properly configured project files which are populated with ready configured and labelled audio elements. The spatial organisation of the control room, brought about the use of metadata and annotated for its anticipated use, is crucial for monitoring the recording process and providing collaborative feedback about performances. Additionally, the talkback audio is captured alongside the multi-track recordings as an alternative method of annotating the recordings with editing and production decisions that can then be carried forward to inform the editing and mixing stage that follows the recording session.

5.3 OVERDUBBING

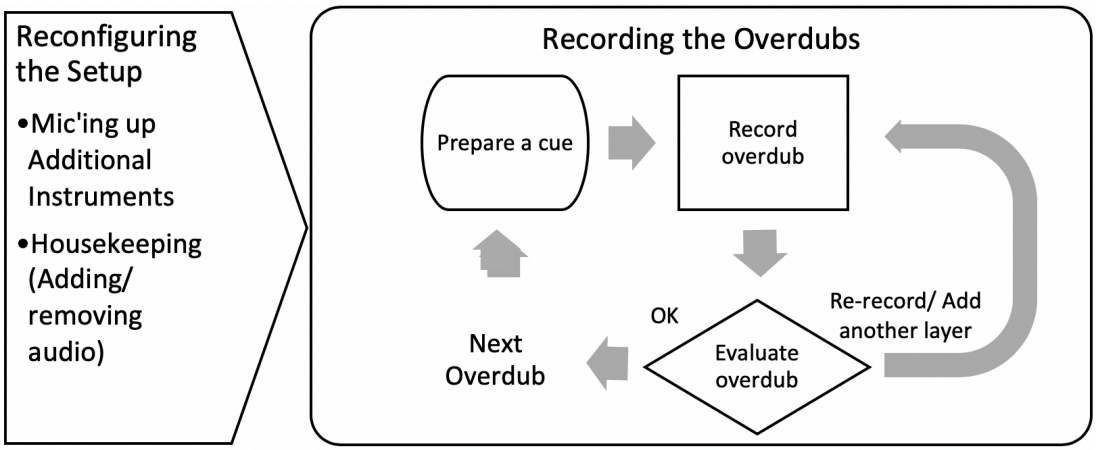


Figure 40 - The Flow of Overdubbing Activities

In the overdubbing process, the members coordinate to layer additional instrumentation and vocal performances over the songs captured in the recording stage. This process is summarised in Figure 40 and as follows:

- *Reconfiguring the setup* - involves adapting the recording equipment to include additional instruments and vocal parts, and to provide for a new orientation of work.
- *Recording the overdubs* – involves capturing the musicians' performances in synchrony with the pre-recorded songs, rather than in coordination with other musicians. This requires the members to collaboratively *prepare cues* in the pre-recorded music as a prompt for *recording the overdubbed* performance over the correct part of the son, which is subsequently *evaluated*.

Overdubbing is essentially an extension of the recording process and shares many of the features and methods detailed in the setup and recording stages of the process and so are cross-referenced to descriptions in previous sections for brevity. The remainder of the description in this section focuses on the methods and practices unique to the overdubbing processes.

5.3.1 A) Reconfiguring the Setup

Reconfiguring the setup consists of two constituent tasks summarised as follows:

- *Mic'ing Up Additional Instruments* – involves setting up recording equipment to capture any new instrumentation that is to be layered over the existing songs.
- *Housekeeping* – involves adapting the recording configuration to add any audio elements required for the overdubbing process and to remove any redundant legacy elements from in the recording stage.

Mic'ing up Additional Instruments

Any instrumentation to be layered over the songs that have not already been setup are added to the configuration at this stage of the process in a repeat of the mic'ing up task, as detailed in the setup section (see: Extract 2 – Mic'ing up a guitar, on page 85). Briefly this task includes *choosing and positioning microphones* to capture the instrument's sound; *line checking* to ensure the equipment is working and to shape the sound; and *mapping and labelling audio* to organise the control room space and provide for the recording activities. There are two key differences to this activity in the overdubbing stage:

- *Firstly*, instrumentation is typically recorded with no other real-time musical accompaniment and musicians synchronise their performances with playback of song through headphones. This means that spill from other instruments is no longer a concern and so opens up possibilities in the choice and position of microphones.
- *Secondly*, the affordances of committing audio mapping and organisation to a template in the DAW are no longer available at this stage, since the work is now concerned with adding to existing song information rather than generating it from new. Any new mappings for the additional instruments then, must be applied in the DAW to each of the song files created in the recording stage one at a time.

The second most of these processual differences is also a principle concern for the addition and removal of other audio elements and is addressed in the next part of the reconfiguration task: 'housekeeping'.

Housekeeping (Adding/removing audio)

Housekeeping involves adapting the configuration of recording equipment and song data, to prepare for recording the overdubs. In this study, the multiple headphone mixes required for ensemble performance are removed, leaving only one feed for each of the live rooms intact. In turn this frees up several recording console channels that are reallocated to sums, or sub-mixes of the new instrumentation. This variously includes additional 'thickener' electric guitars; acoustic guitars; and backing vocals over the songs, for which the recording engineer creates and configures new audio tracks and sums (sub-mixes) in each of the DAW song files that are in turn outputted to the reallocated recording console channels.

5.3.1 B) Uses of Metadata in Reconfiguring the Setup

In reconfiguring the setup for overdubbing, the engineer uses the same methods for mapping audio that we encountered in the setup stage of the process and in doing so draws upon the same methodical uses of metadata (see pp. 85). Uniquely to this stage of the process, however, these metadata are variously reused, created from new, or discarded in the transition to a new orientation of work. In Extract 9 below, the recording engineer (Paul) talks through the reconfiguration of the recording equipment in preparation for recording overdubs.

Extract 9 - Housekeeping

Glenn: Are you rearranging the routing then?

Paul: Yeah, I'm just… …I'm getting it… …I'm getting rid of a load of bits and pieces… well not loads of it, just, some of the yeah, because there were loads of different headphone mixes going on yesterday erm… I'm just putting it in a location where it's a bit more user friendly for me… in here (the DAW), just so I can pull a few more bits down out onto the desk (recording console) erm…

Glenn: Are you routing the groups onto the (desk)?

Paul: Yeah, I'm just sort of grouping and summing erm all the individual er… takes (inaudible) a master kind of guitar and er… it just means, like I say, I pull things out a bit quicker

Glenn: Are you re-routing the headphones altogether?

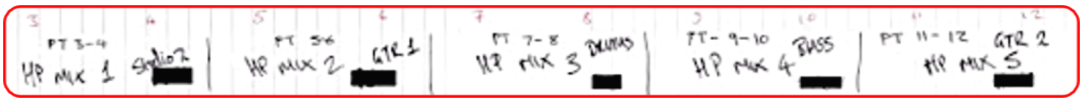
Paul: Erm, no all I'm doing is re-routing… getting rid of the headphone feed for drums, bass and guitar (musicians) because we're not gonna need that… er, one of the guitars I should say. Er, I'm make sure, because I'm setting up for the backing tracks as well… …not backing tracks sorry, that's the wrong word erm, overdub tracks… …so I've got all that routed (inaudible) again its just, it's just for speed of use when it comes to actually doing the session erm… …I'm trying to anticipate what they may ask as well, I've not touched any of the mics or any of the setting or anything like that, that's all… …I want it to sound the same as it did yesterday, the guitar, because he's (Richard, the guitarist) literally erm… he's just using it for thickening, he's a bit paranoid his guitars are going to sound a bit wazzy which it won't.

Glenn: That a technical term?

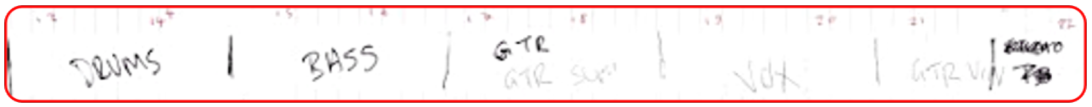
Paul: A bit wazzy? Yeah… and just you know, clearing up a few bits that I don't need erm (inaudible) DI guitar that the track got created and we didn't end up using… …just a general housekeeping really.

Here the recording engineer is applying changes to each of the song files recorded on the previous day, including mapping and labelling new tracks for acoustic guitars, backing vocals, and layering up the electric guitar parts to "thicken" the sound, as anticipated from his interpretation of the band's artistic requirements. The changes also include providing for the work practices in the overdubbing stage such as "pulling down", or mapping, sub-mixes of the new instrumentation to the recording console to make the configuration "a bit more user friendly". This part of the reconfiguration involves reallocating some of the recording console channels, which are subsequently relabelled, as shown in Figure 41 below. In the process, the previous configuration is archived in both digital form, saved as a version of the DAW project files, and in its associated physical as the labelling strips are hung on the back of the control room door (Figure 42). This archiving provides the engineer with the contingency to reconstruct any part of the configuration if some corrective action be necessary sometime after the recording session.

Channels 3-22 in the Recording Stage



3-4	5-6	7-8	9-10	11-12
Headphone mix 1 (Singer – Studio 2)	Headphone mix 2 (Rhythm Guitarist)	Headphone mix 3 (Drummer)	Headphone mix 4 (Bass player)	Headphone mix 5 (Lead Guitarist)

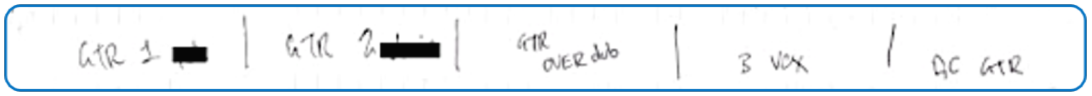


13-14	15-16	17-18	19-20	21-22
Drums (sub-mix)	Bass (sub-mix)	Rhythm Guitar (sub-mix)	Vocals	Lead Guitar (sub-mix)

Channels 3-22 in the Overdubbing Stage



3-4	5-6	7-8	9-10	11-12
Headphone mix 1 (Studio 2)	Headphone mix 2 (Studio 1)	Drums (sub-mix)	Bass (sub-mix)	Vocals



13-14	15-16	17-18	19-20	21-22
Rhythm Guitar (sub-mix)	Lead Guitar (sub-mix)	Guitar Overdubs (sub-mix)	Backing Vocals	Acoustic Guitar (sub-mix)

Figure 41 – (Top) Allocation and labelling of recording console channels 3-22 in the recording stage; (Bottom) Reallocation and labelling of recording console channels 3-22 in the overdubbing stage.



Figure 42 - Labelling strips from recording sessions stuck to the control room door for future reference.

5.3.2 A) Recording the Overdubs

Recording the overdubs is a process of recording musicians' performances of musical parts done in synchrony with playback of the pre-recorded songs and layering those recordings over the song. This involves three key collaborative activities, summarised as follows.

Preparing a Cue

Before recording any performances, the members listen to playback of the song recordings to establish musical cues to lead in the musician's performance of the overdubbed part. Several cues may be necessary for one song where the song is to be edited together from various takes, or only certain sections of the song are to be layered, for example adding backing vocals to the chorus. This involves a collaboration between the recording engineer and the musician to operate the DAW and find a point in the playback of the song at which the new musical parts are to be layered. In most cases this involves a providing a 'lead-in' to the performance so that the musician can pick up the tempo of the song before commencing their performance.

Recording Overdubs

As summarised so far, the aim of the overdubbing process is to capture musical performances in synchrony with the pre-recorded song, rather than as an ensemble performance with other musicians in real-time. This recording method affords the musicians broader opportunities for collaboration in experimenting with layering sound but is one that requires the recording engineer to manage the composition of multi-track audio carefully. For example, as the layering of vocal harmonies yields musical trial and error, each new layer may require inclusion or exclusion from the music-mix and headphone mixes to continue the process and develop the musical arrangement of the song, this in turn requires some critical listening and collaborative evaluation.

Evaluating Overdubs

Similar to the main recording process, each performance is recorded in takes that members subject to evaluation, in order to inform decisions about the next activities in the process (see pp. 95). In the recording stage this includes rejecting and re-recording unsatisfactory takes, or approving a take then moving on to record the next song. Experimentation in the overdub process may give way to further evaluative decisions that might include recording additional layers to 'thicken' or harmonise a musical part or to perform a take in a different way. The process of layering sound then continues to cycle through the preparation of cues followed by recording overdubs and evaluating the outcome.

5.3.2 B) Uses of Metadata in Recording Overdubs

Drawing on Waveform Graphics and Audio Annotations

The focus on methodical uses of metadata in recording the overdubs is centred on the use of waveform graphics in the task of setting up cues, which again is tentatively included here. Waveform graphics are automatically generated in the DAW for all of recorded or imported audio data in the composition and are methodically drawn upon for a range of activities; as such these graphics display a resemblance to metadata as a processual resource that represents underlying audio data, albeit graphically. The use of this resource in the overdubbing stage is demonstrated in Extract 10 below.

Extract 10 - Setting up a cue.

The members are in the control room and are preparing a cue for the rhythm guitarist (Richard) to record an acoustic guitar part layered over their recording of Take it Easy by the Eagles. The singer (Chris), and the recording engineer (Paul) are involved in the collaboration.

Paul: Just (need to) find the right take first. I think it was the last one.
Paul: [Clicks to position the timeline marker; starts playback, the song begins after 5 seconds]
Paul: [listens for 4 seconds, then stops playback; zooms in on timeline and auditions the cues two more times]
Paul: Does the acoustic guitar come in straight at the beginning?
Chris: Yeah.
Paul: (Inaudible) counting four (inaudible).
Paul: [Scrolls and zooms edit window view to focus on the recorded talkback audio; solos talkback track and auditions to listen for the verbal "1-2-3-4" count-in captured in talkback]
//Transcript abridged//
Paul: Right so this is the take that we're (inaudible). [stops playback] Just need to make that one-two-three-four nice and loud for you.
Paul: [Performs edits to create a clip from the talkback audio and boost the level, to create an audible cue for the guitarist; plays the song back to audition the cue (Figure 43)]
Rich: I think I can pick that up (Paul).
Paul: You pick that u… (Inaudible) …I'll crank it right up [Clicks to increases gain of the clip with clip gain slider] so if you… (try it out) [starts playback]
Rich: [Listens to playback, and begins playing the acoustic guitar on cue.]

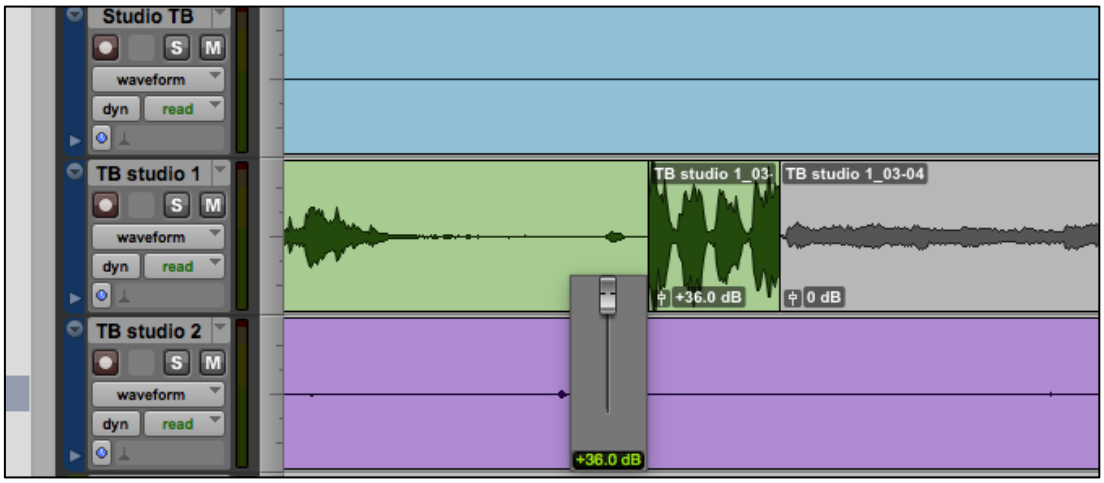


Figure 43 - Screenshot of the count-in cue with volume boosted

In this example, the collaborations result in the recording engineer creating a cue from the verbal count-in captured in the talkback audio when the song was recorded, in order to provide the guitarist with a prompt to begin his performance in synchrony with the rest of the pre-recorded instrumentation. The waveform graphics provide the recording engineer with a visual resource with which to locate and prepare the cue point in the song data and is drawn on in tandem with auditioning the audio playback. Also note: the count-in captured in talkback and drawn upon in this task is similarly included here as a resource that bears a resemblance to metadata: voice annotations such as this, and others (see also Generating Voice Annotations, pp. 99), are information extra to the musical data that in turn provides an account of the process.

A Further Example of Metadata as an Integral Resource in the Process

A feature of the overdubbing stage is that the recording configuration is continuously adapted as layers of sound are added songs, an approach that stands in contrast to the main recording stage in which the configuration is fixed. This ongoing reconfiguration is done in response to the collaborative development of the songs which, apart from the musical choices, involves establishing a cue point to start recordings; creating and mapping new audio tracks; and managing the mix of audio in the foldback system. The methodical uses and creation of metadata in these activities are, as explored previously in mic'ing up (see pp.85), an integral feature of the work as new tracks are labelled and mapped to the configuration. In Extract 11 below, one further example is given from the overdubbing stage that demonstrates the social character of the collaborations involved overdubbing some backing vocals, which is followed by an example of the resulting organisation and labelling of the audio.

Extract 11 - Layering vocal harmonies (adding some oo's)

The recording engineer (Paul) and the bass player/backing singer (Alan) are in the control room preparing to layer some backing vocals, consisting of an "oo" sound that Alan sings over the choruses of the band's recording of Take it Easy by the Eagles. With the base melody already layered, Paul and Alan have collaborated and settled on a harmonising vocal which they plan to record next.

Paul:	Right Let's find out where our oo's are. [zooms in on audio tracks in the DAW].
Alan:	It's after the second take on the chorus.
Paul:	[Positions timeline marker before chorus; starts playback]
Alan:	It's the third one (vocal phrase)… (the vocal phrase 'take it easy' repeats twice) now!
Paul:	Yep [stops playback] that's one oo! Then there's another one [positions timeline marker later in the song] then there's another one…. [starts playback, second chorus is heard] …yep, so what I'll do is, I'll come in (start playback) just before to give you a count-in. Do you want your original (points at DAW display) erm (backing vocal in foldback mix)...
Alan:	Yeah, on there so I can harmonise off that
Paul:	Well, I'll give you the line before so you can get your pitch in.
Alan:	[Leaves control room for live room two]
Paul:	(to talback) Hello, what I'm going to do is play this back see if this an OK punch in part. Would help if I've got the right input [reconfigures input of new track; starts playback from cue; stops playback after a few seconds] Is that an OK lead in for you?
Alan:	Yes, yeah.
Paul:	OK we'll try it from there [starts DAW recording]
Alan:	(sings 'oo' vocal parts in time with the playback of the song chorus)
Paul:	[Stops DAW recording] that worked for me!

Alan: Is that alright?
Paul: It's good, it lifted it quite nicely. Right, we'll jump onto the next one. [positions timeline marker before second chorus] again it'll come in just the line before. [starts DAW recording]
Alan: (sings 'oo' vocal parts in time with the playback of the song chorus)
Paul: [Stops DAW recording] Yeah, that's cool I like that.
Alan: I don't know if there's any more of that.

This extract demonstrates a collaboration to establish performance cues, the performer's requirements for foldback mix, the performance and recording of the overdubbed parts, and the evaluation of those performances. Subsequent to the example above, the members go on to record a further layer of backing vocals in a lower register to 'thicken' the vocal sound, resulting in a total of four backing vocal layers. As shown in Figure 44, each new track for the



Figure 44 – Detail of the organisation and labelling of the four backing vocal layers, including the sum mix.

5.3.3 Summary of the Overdubbing Stage

In the overdubbing stage the members collaborate to layer additional instrumentation over the recordings of real-time band performances, to complete the songs. This begins with preparations to reconfigure the DAW and the physical recording equipment by mic'ing up additional instruments; adding sub-mixes for the anticipated new musical parts (backing vocals etc…); and the removal of redundant elements of the configuration (e.g. surplus headphone feeds). With the equipment reconfigured the engineer collaborates with the musicians to establish the intended arrangement of the additional musical parts and to prepare for recording individual performances to layer sound over the song. This involves preparing cues in the playback of the song to provide the musician with a lead-in to their performance, and adapting their headphone mix to enable the coordination of performance. As per the main recording stage, performances are also recorded as 'takes' and are subject to critical evaluation of their performance, however unlike the recording stage, the overdubbing process affords some experimentation with layering sounds, but which requires ongoing reconfiguration work.

About the Metadata

The key differences in metadata use in the overdub process, in comparison to the setup and recording stages, include firstly, the archiving of physical metadata resulting from reorganisation of audio in the transition from the recording stage to the over dubs. This is crucial for correlating the musical data archived in the DAW with the physical studio configuration, should this need to be called upon at a future stage. Secondly, The use of non-textual representations of the musical data. The waveform graphics and structure of the audio in the DAW are used for navigating the multi-track audio to find cue points in songs. Also, the audio annotations captured in talkback are used where cue points are more difficult to prepare with the recorded "one-two-three-four" count in providing a cue point. Although non-textual metadata might not be initially recognisable as metadata, these nonetheless present the engineer with a representation of the recorded audio that indicates the structure of the song and is useable in the process of layering sound. Thirdly, Continual reconfiguration of consistent elements of the configuration: highlighting the potential for metadata driven applications to facilitate more flexible approaches to the reusing musical data.

5.4 SUMMARY OF A STUDY OF RECORDING STUDIO PRODUCTION

This study observes the collaborative activities of a band of five musicians and a recording engineer to create recordings of real-time performances in a three-day recording studio session, with each day dedicated to a different stage of the process: setup, recording, and overdub respectively. The setup stage involves configuring and

testing the equipment and the studio space to both prospectively support the accomplishment of real-time musical performances and the successful capture of those performances to multi-track audio. This requires the partial separation of band members to capture sounds in total or near isolation and the use of a 'foldback' system to create a complete communication loop between the band. Foldback also enables the recording engineer to co-ordinate the recording activities, as does the organisation of the recording equipment around his working position in the control room. The recording stage involves the members carrying out the activities provided for in setup: recording performances of a song and collaboratively evaluating each 'take' for its musicality. Finally, in the overdubbing stage additional instrumentation is recorded and layered over the recordings to complete the musical arrangements of the songs.

About the Metadata

To summarise the metadata and its methodical uses in this process, three broad categories are proposed:

Firstly, *Generic metadata*. This is the information inscribed on the recording hardware and in the software interfaces that indicate the audio mappings and interconnections of the studio equipment. These metadata embody the *spatial organisation* of the studio and are methodically drawn upon to map audio from its source to its destination, via an array of other supporting and organising resources (studio monitor speakers; headphone feeds; audio controls and level meters).

Secondly, there is *situated metadata*. This is information encapsulated in the recording engineer's annotations applied as physically written labels on the recording console, and the digital labels applied to virtual audio elements in the DAW and play a role in *retrospective-prospective coordination* of the process. These annotations retrospectively document shorthand *descriptive* information about the recording configuration such as the microphone type and/or position used to record an instrument. In tandem with their spatial organisation, annotations also *prospectively* provide for a range of anticipated activities and contingencies, including editing and mixing stages external to the recording studio session

Thirdly, there is *peripheral metadata*, or the 'everything else' category of metadata that might be secondary to the process, for example, annotating faulty hardware ensures defective resources are bypassed but also informs maintenance work to be undertaken at another time; or used ephemerally, for example the representative test recordings used as a collaborative resource which are discarded immediately after use.

Finally, there are subcategories of these metadata based on *modality*, whether digital or physical inscriptions as above, or as is tentatively proposed in this thesis, non-textual resources that bear resemblance to metadata. These includes *representative* data about data such as wave form graphics, or test recordings; and *documentary* information such voice annotations.

Chapter 6
A Study of Home Studio Production

This chapter presents the findings from a study of home studio production as a set of constituent methods that are performed sequentially and repetitively toward making 'tunes' composed for club DJs to incorporate into their performances. In the first part of the chapter we explore a series of methods that the producer employs to create and organise music-making resources. In part two we see the producer draw upon those resources and employ a different set of methods to create a 'tune'. In the third part, these methods are employed again but toward reorganising and finalising the tune in a mixing and mastering process.

Introduction

Consumer audio technologies have open up possibilities for home-centred music production since the 1980's [1], however in recent years the ease of access to Digital Audio Workstation (DAW) technology and digital music marketplaces that has been instrumental in affording the ability to produce music from end-to-end [2]. Music practitioners can now build studios in their homes with a PC and a minimal amount of equipment, drastically reducing studio costs and making time for more experimentation and creativity, albeit with reduced scope in production possibilities within small domestic spaces (recording loud instruments or ensemble performances, for example, are almost certainly practically excluded from these production sites).

The location for the study is an electronic music producer's studio built in a spare room of his home, which is centred on a DAW workstation used to create music for his own independent record label. Little or no profit is made from record sales as the music is primarily made to be played in a club environment, which in turn attracts income from DJ performances by business partners that showcase the label's original music. The study observes the producer working alone to complete an end-to-end process of creating original music from scratch; reworking and updating an original song; and finishing music in a mixing and mastering process. As the producer largely works through the entire process alone, the role of metadata is not as overt in these activities compared to the other studies, in which the producers use metadata to organise and describe audio to successfully coordinate *discrete* parts of a broader process. In this study, the organisation of sound *iteratively evolves* as elements of sound are added to the composition through processes of experimentation with sound.

Nonetheless metadata is still created and drawn upon as sounds are created, layered, treated and shaped toward the final product.

6.0 THE FINDINGS

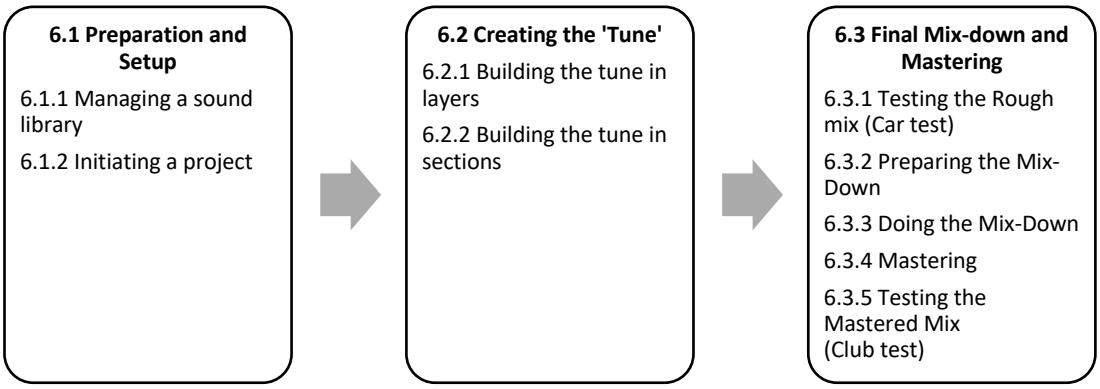


Figure 45 - An Overview of the Home Studio Production Process

The findings unpack the real-time accomplishment of organising, creating, assembling, and shaping digital resources (sound files) into a song, within the home studio setting. This includes several iterative processes, in which DAW software is used to assemble songs from sounds in a local library and sounds created using virtual instrument (VI) software; to experiment with, layer, blend, and shape sounds; and to analyse the treatment of sounds. The process is broken down into three main stages:

- *Preparation and Setup* describes the producer's methods for preparing resources and setting up the DAW for music-making.
- *Creating the 'Tune'* describes the producer's methods for music-making by creating and assembling audio and MIDI clips using DAW software.
- *Final Mixing and Mastering* describes the producer's methods for mixing and mastering songs into a final product fit for release.

The activities in each section then are broken down into more detailed descriptions of the constituent actions followed by a summary of the metadata drawn upon and created in doing each activity. As in the recording studio study, the descriptions of activities in each stages are necessarily glossed over in certain aspects, as this kind of production work involves highly detailed and technical understandings of the treatment of sound, which again has the potential to draw our interest away from our focus on the *social character* of the work and the role of production information used in the process. Following the descriptions of the activities then, is an exploration of the *methodological uses* of production metadata used and created in the process. In order for the reader to gain some appreciation of the kinds of metadata at play in the recording engineer's work, these descriptions are supplemented with figures and vignettes extracted from transcriptions of the video field data.

6.1 PREPARATION AND SETUP

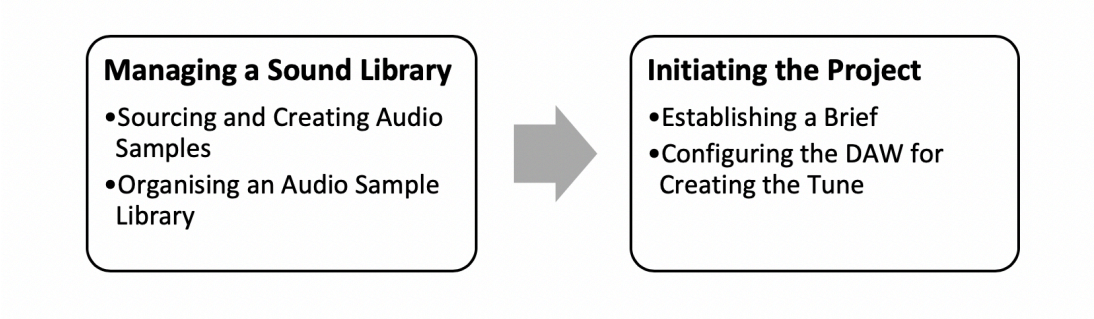


Figure 46 – The Preparation and Setup Activities

The preparation and setup stage of the process provides the groundwork for creating the tune and involves activities shown in Figure 46, summarised as follows:

- *Managing a Sound Library* – involves sourcing, creating, and organising collections of audio samples, to prospectively provide resources for creating tune
- *Initiating the Project* – involves establishing a creative brief, often with collaborators outside of the studio environment; the exchange and preparation of musical data; and configuring the DAW to provide for the flow of work in the following stage.

6.1.1 A) Managing a Sound Library

Sourcing and Creating Audio Samples

Audio samples are used extensively in the composition process, which includes assembling the song from clips of drums; vocals; movie, TV, and game dialogue; sound effects; and acoustic and electronic instruments. The producer sources audio samples from media found on the internet; commercially available sample library CD's; or creates them from scratch using virtual instrument technology or recording equipment. These are stored and organised locally as audio files in a digital library to be drawn upon during the production process. Sourcing and creating audio samples is not a direct part of the process of creating a 'tune' as such but is part of the producer's wider practice and is aimed at providing resources for the creation of tunes.

Organising an Audio Sample Library

Methods for cataloguing the sample library includes managing a hierarchical folder structure on the studio PC, which is organised according to criteria such as instrument type; sound effect type; a commercially compiled collection; genre specific sounds; or resources assembled and archived for a specific music project. This organisation affords the producer the ability to browse and retrieve sounds as they are needed

throughout the production process, however as we will see in the following section this can be an onerous task that requires the producer's use of metadata-driven tools.

6.1.1 B) Uses of Metadata in Preparing and Organising Production Resources

The producer's practices outlined above prospectively provide resources for the music-making process, which in turn requires a degree of human-initiated metadata work which we detail next. Computer file systems and digital library applications of course turn upon machine-readable metadata in order to support functionality of human interfaces and in the following examples we explore how the producer exploits such functions and reshapes their intended uses in order to support his music production practice.

Experimenting with Sounds to Create Production Resources

In order to apprehend the methodical uses of metadata in preparing and organising the production resources, we must first explore some background to the producer's methods. As detailed above, the producer often spends time sourcing and creating samples and just how this is done is the subject of later sections, for now one particular aspect of these methods is significant to the producer's metadata work: the key signature, or musical pitch of the samples he creates. In Extract 12 below, the producer (Steve) explains how he uses a VI plug-in with an extensive range of built-in sounds to generate samples for his own sound library.

Extract 12 – Bouncing it all in F

Steve: It's basically just everything you ever need. So it's got keys (keyboard/synthesiser sounds) and things like that, then you've got a whole section of film effects you can tweak, it's really good.

Glenn: Is it a whole DAW or just a plug-in?

Steve: No it's just a plug-in, but like I say… (sounds are) …maybe, 2-3 gigs (Gigabytes) per instrument and there's just hundreds of them. Everything from Moogy (Synthesisers) to… effects… basses… not only that, there's hundreds of effects to it. To be honest it's endless and I don't use it that much. To be honest it's quite (processor) hungry so what I end up doing is like having a day of finding stuff and bouncing it all in F (laughs) anything I like I just bounce it in F and be done with it. But yeah, it's a well groovy patch.

Preset sounds are triggered in a VI using a MIDI piano keyboard and manipulated and shaped using virtual controls in real-time, which the producer might do over the course of day to explore and experiment with sounds, and 'bounce' them (render the real-time virtually generated audio to a digital file). Note that the producer speaks of creating sounds in the key of F. This, according to the producer, places the fundamental frequencies of the bass at around 49Hz which optimises the bass volume on a broad range of club sound systems, but are also easier for DJ's to segue and mix live alongside similarly music produced for the genre.

Creating Metadata to Support the Music-making Process

Sound clips in the key of F are critical to the music-making process then, whether the producer prepares them, per the above activities, or whether they are found sounds from other sources. The ability to search and filter the vast amount of data in his local library for sounds in the correct key is therefore crucial to the music-making process, which the producer provides for through a self-devised process of generating and attaching metadata to audio files. This process appropriates the audio analysis functions of specialist DJ software designed for managing and sorting large song collections by key signature and tempo, amongst other musical parameters. Although not designed to manage short clips of audio, the producer nonetheless uses the software tools to analyse files in his sample library for musical parameters, including key and tempo, which are then automatically appended to the file names. This enables the producer to use the PC's native search functions to retrieve sounds according parameters that match a particular search term. For example, in Extract 13 below the producer (Steve) draws on his local sound library to find sounds to add to a composition, which is in the key of F Minor (appended to file names by the analysis software as '4A').

Extract 13 - Demonstrating Mixed in Key Software for Metadata Creation and File Retrieval

Steve: Could now add some textures [minimises the DAW software to reveal the OS desktop] to be honest this is the bit that's boring because all you end up doing is searching… …SEARCHING for the perfect sample. [eyes scan several folders and files on the desktop] er… question is, where is it? Let's do like a [clicks to open a file explorer window] search [types '4A' into search box and types enter key, waits for computer to return search results]

Glenn: You're just using Windows search?

Steve: Yep, I'll find as many files in 4A as I can.

Glenn: 4A, what's 4A?

Steve: 4A, using the... [opens an internet browser] this scale right [clicks on shortcut in favourites bar, image results are returned in browser] mixed in key scale… (Figure 47)

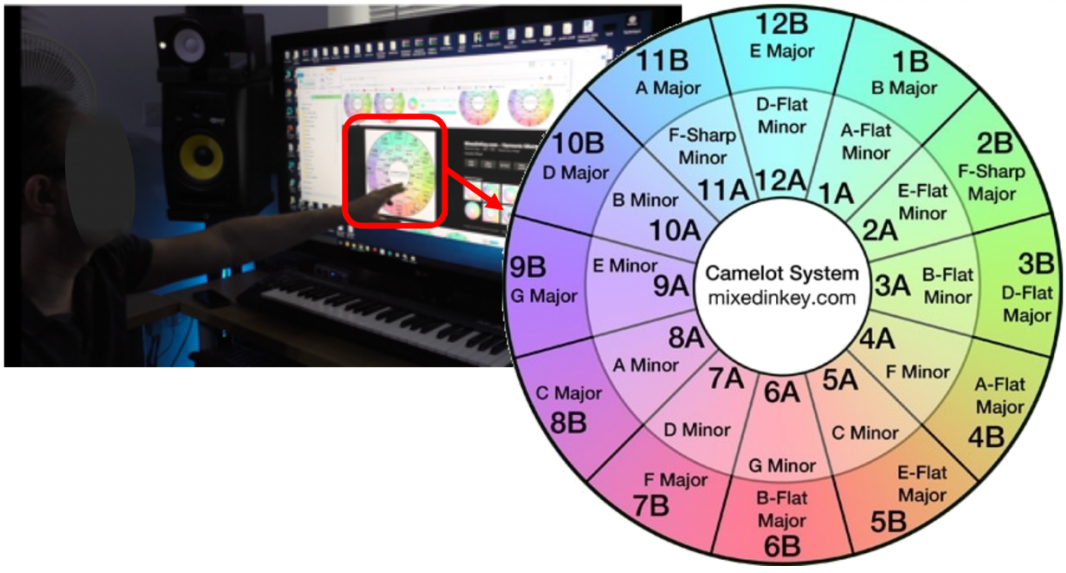


Figure 47 - Referencing the Camelot System used by DJs for harmonically matching and mixing songs. (retrieved from www.mixedinkey.com)

Glenn: Ah yeah right, sure. OK you showed me this before.
Steve: So basically, everything (points at the graphic on screen), certain things mix (harmonically) with certain other different things… err and then what I do is use Mixed in Key (software) to basically scan a vast majority of…
Glenn: So, you use that to scan (analyse) your things (files) and it adds some metadata on?
Steve: It does it automatically. So, say for example… let's just find something I can use, just to show you what it does [minimises file explorer window, opens Mixed in Key (MiK) software]… ….Just as an example [drags file into MiK window] put that in there and show you what it does [MiK software displays analysis progress] so it just basically goes through it [MiK displays analysis results: Key '4A'; Tempo 87] and just detects what speed it is and what (key signature) [places mouse pointer over result] …which is just, you know what I mean, half the job. [closes MiK software and restores explorer window] …so now here's… [scrolls though search results returned with '4A' included in the file name] …to be honest I should have done it just on the folder with samples in because it's given me absolutely everything, all my tunes and everything.

Retrieval of sounds from sound libraries is key feature of the producer's work to create songs and so preparing and organising production resources through effective local management of sound files is essential. The producer's custom methods for generating and drawing on metadata, as outlined in the example above, demonstrate the role of metadata in localised workarounds that provide for the task of searching, browsing and auditioning sounds in the tune creation stage of the process.

6.1.2 A) Initiating the Project

Establishing a Brief

Other preparations are more specific to the aims of a musical project and are often underpinned by some form of artistic brief in collaboration with stakeholders such as other artists, producers, or DJ's. In the study, two song projects are initiated, but with differing briefs originating from prior discussions with partners on the record label and a collaborating artist respectively. The first song project aims to provide the record label DJs with some original songs to perform with on an upcoming tour, with the only artistic constraints being that the song fits the 'Drum 'n' Bass' music genre and features current musical trends. The second project has similar aims and constraints but focusses on reworking an existing song with new musical parts to incorporate current musical trends and production methods. Both projects draw upon the local sound library and experimentation with sound to assemble songs in the DAW, however the latter project requires the exchange and use of pre-existing song data. Establishing a brief then, turns upon the members to collaboratively anticipate an artistic outcome, which is accounted for in the resulting collection of digital resources that provide for the tune creation process. These resources in turn are a prerequisite for the preliminary tune creation task: setting up the DAW.

Configuring the DAW for Creating the Tune

Songs are created using DAW software, which affords the producer with an array of functions to experiment with sounds and assemble audio samples. The flexibility of the DAW to support a range of production scenarios and tasks requires it to be configured to provide for the anticipated flow of work. In the case of tune creation, the producer must be able to work quickly to not only create a composition of sounds but to treat the layers of sound to create a polished music mix, a task that is conventionally done after a song has been created. The DAW configuration includes:

- Busses, or sub-mixes to group the layers by musical 'parts', such as drums, bass, or sound effect tracks. Busses are also treated with automatic gain controls that can be set up to provide an approximation of the finished music mix, which in turn aids the creative process.
- Analytical tools such as loudness meters, frequency analysers, phase meters, and mono/stereo mix analysers, which are used methodically to shape musical parts and the overall music (detailed in later sections).

This audio configuration enables the producer to quickly apply treatments to grouped sounds, balance each group as a part in the music mix, and quickly evaluate the whole song to inform the creative decisions in the process.

6.1.2 B) Uses of Metadata in Initiating the Project

Scaffolding the Creative Process: 'getting the vibe going'

In Extract 13 below, the producer creates and configures a new project file in the DAW, per the above task, which involves a process of setting up some signal routing and sound treatments to scaffold the composition process in order to "get the vibe going" and support the creative process.

Extract 14 - Setting up the DAW to "get the vibe going".

Steve is sat at the DAW in his home studio initiating a new project to create a tune and is configuring signal routing and treatments.

Steve: So generally, what I always do is kind of, set up all my busses and stuff first…

//transcript abridged
Steve talks through the "stuff", or the analytical tools, he uses in the process before moving onto the "busses"//

…I put a couple of busses in here [creates a bus and labels it 'Ds'(drums)] a erm… call it like a track spacer bus [creates a bus and labels it 'Ts'(trackspacer)] [creates a bus and labels it 'bass'] Bass bus…

Glenn: So busses are like, sub-groups or sub-mixes?

Steve: Yeah so what I'll do basically [points to first track in DAW project window] so I'll have like, maybe kind of pads or or intro noises and then… …send them… …to the trackspacer bus, which basically [drags plug-in preset from menu to 'Ts' bus; opens interface] the Waves Factory Trackspacer (plug-in)… …that keeps everything under the drums, and if I start like that then it… to be honest the end mix it makes it much easier because I'm never fighting for anything, you know what I mean. There's nothing worse than killing er… the

vibe of everything by constantly trying to tweak everything as you go along. We're trying… what you kind of do is get the vibe going first and then really worry about that (the mix) at the end… …I work much faster and… ….here you go [clicks on a mixer context menu to select routing option] I just sidechain the drum bus with the trackspacer so now any of the drums I put through will make all the rest of the music duck…

Glenn: Gotcha

Steve: Yeah? Simple and that's pretty much a default thing that I always do.

The rich detail of the producer's configuration of analytical tools is necessarily glossed over here: these are plug-in tools for analysing complex audio parameters that we will explore further in the final mixing and mastering stage. Of more significance for our focus on the role of musical metadata is the methodical use of the busses, or sub-mixes, through which the audio is prospectively organised in order to automate the music mix. The configuration of busses and the 'Trackspacer' plug-in that the producer describes means that the volume level of the music (routed through the 'Ts' bus) is automatically regulated inverse to the volume envelope of drums (routed through the 'Ds' bus), so making "all the rest of the music duck", put simply: as the drums get louder, so the music gets quieter. This in turn provides for the tune creation process in which the producer's preference is to defer any detailed mixing work, the "tweaking", in order "work much faster" at being musically creative, or as the producer phrases it: "get the vibe going".

6.1.3 Summary of Preparation and Setup

In these preparatory activities, both *general* and *situated* preparations are made in advance of any music-making activities. *General* preparations include finding or creating sounds that are suitable for the inclusion to a piece of club music; categorising and storing sounds in a local library; using software to analyse and add searchable terms to audio file names, for ease of retrieval. S*ituated* preparations are specific to a project and include establishing the artistic aim of the production work such as starting a song from scratch or reworking an old song; assembling sounds ready to be used or reused; and setting up the DAW with groupings, analytical tools and processing.

About the Metadata

Uses of metadata include using analysis software to generate key signature and tempo information about audio files in the local sound library, which is then automatically added to filenames making them searchable in order to provide for the production process. Other uses include setting up the organisation of audio *routing* in the DAW to group audio by type (similar to templating the configuration in the *recording studio* study), although tracks are only created and routed through group busses once the producer begins importing audio to create the song. This, as we will explore in the next section, provides for keeping the layers of sound organised as they are built into a tune.

6.2 CREATING THE 'TUNE'

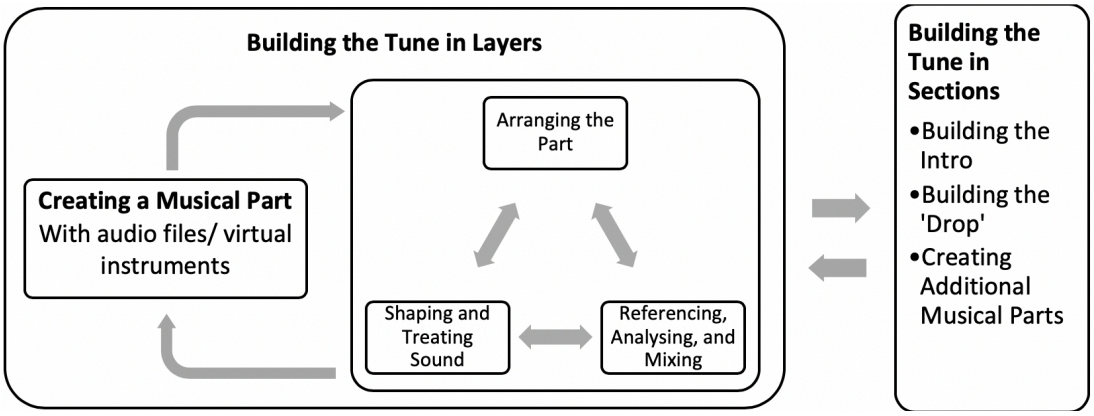


Figure 48 - The Activities in Creating the Tune

Creating the tune involves a set of activities concerned with iteratively building a composition of audio in the DAW, as shown in Figure 48. The two overarching concerns are summarised as follows:

- *Building the tune in layers* – involves creating and layering 'musical parts', which are created as a short loops (e.g. 8 or 16 bars) that are shaped, musically arranged (melody, harmony, and rhythm) and mixed alongside other layers, until all or most of the musical elements have been created.
- *Building the tune in sections* – involves copying and pasting the musical parts to structure the tune into sections (intro, verse etc). This includes creating a 'build up' or climactic point in the tune which foreshadows the 'drop', in which all the musical elements are instantaneously introduced for dramatic effect.

The term 'musical parts' refers to recognisable layers of sound making up the song, e.g. drums, bass, vocals, sound effects etc. These layers might otherwise be termed 'instrumentation', however a careful distinction is made here in using the term 'parts', as the producer uses digital tools instead of traditional musical instruments to create sound in new and interesting ways using methods which we explore next.

6.2.1 Building the Tune in Layers

This section details the methods for creating the musical parts in the DAW that are layered to build up the composition. Methods differ slightly dependent on whether the musical part's constituent sounds originate from digital audio files or a VI plug-in, although the remainder of the process is consistent in its practice. Creating musical parts then involves the musical arrangement and treatment of sound to shape the musical part, and some analysis to place it in the music-mix. The activities described in this section are repeated to build the tune layer-by-layer, in and iterative process of experimenting and developing each part and referencing them back to an overall musical idea.

Creating Musical Parts with Audio Files

As we have established so far, a library of audio samples is a fundamental resource that provides for the tune making process. The methods for drawing on this resource to create the tune's musical parts, involves searching/browsing, auditioning and importing audio files from the local sound library to the DAW. Using the PC's native file explorer, the producer searches and browses the local library (see Extract 13, pp 118) and goes through a process of opening and listening to sound files using the computer's media player to audition them. This action layers the auditioned sounds over a playback loop that the producer sets up in the DAW, in order to reason about the suitability of a sound clip in relation to of any parts of the tune that are already in place. Any sound clips that are found to be suitable, are either transferred, by dragging and dropping to a temporary folder on the PC desktop for later use; or imported directly to the DAW, again by dragging and dropping files (see Figure 49 below).

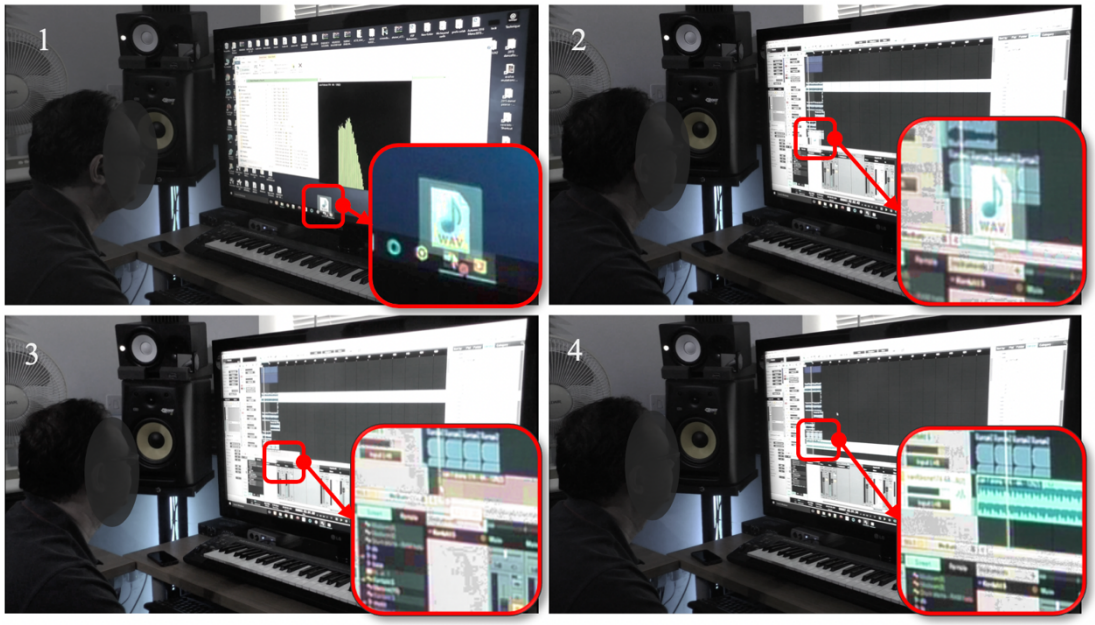


Figure 49 - The importing audio to the DAW:
1) Dragging the auditioned sound file; 2) Dropping the file in the DAW edit window; 3) The DAW generates a new audio clip and track; 4) Import complete with waveform graphic and labels.

On importing to the DAW, an audio clip is automatically generated in the edit window, which is the area in the DAW used to assemble sounds and build the tune. Audio clips are contained in tracks, which are used to layer sound, and are labelled with its original file name. In the case that a file is dropped in a blank section of the edit window, the DAW to creates a new track labelled with the sound file's name to contain the audio clip. This is the first step in creating a part using this method, alternatively, as will be explained next, the Discovering and importing audio is the first step in creating a part using this method, as is the alternative method of using VI's to generate sounds which is explored next.

Creating Musical Parts with Virtual Instruments

Musical parts may also be created using VI's, which are DAW plug-in applications that use audio sampling and synthesis processing to create new and interesting sounds, and to emulate traditional musical instruments. Sounds and their synthesis parameters are triggered and controlled in the VI using a combination of peripheral devices such as MIDI piano keyboards and virtual controls in the VI and DAW interfaces. To set up a VI the producer creates a MIDI track in the DAW, which handles musical note and control data rather than audio, with a VI plug-in set up in-line with the MIDI data flow on the track. This configuration allows the VI's sounds and parameters to be triggered and controlled in real-time, or from playback of recorded or programmed MIDI data, affordances which the producer uses to experiment with and audition sounds. Similar to creating parts from audio files, the producer sets a playback loop running in the DAW while simultaneously auditioning sounds. This involves repeatedly browsing and selecting pre-programmed sounds in the VI interface, then experimenting with triggering sounds and playing with synthesis parameters using the MIDI keyboard and virtual controls (using a PC mouse) respectively, until a suitable sound is found. Again, this is the first step in creating the musical part using this method.

Arranging the Musical Part

Once sounds are discovered or created using the techniques above, the producer then experiments with the musical arrangement of sounds in the DAW edit window to develop the musical parts making up the song further. Again, arrangement methods differ depending on whether the sounds originate from an audio file or from a VI, as detailed below.

Arranging with Audio Clips

Once imported to a track, the producer then variously drags, copies and pastes audio clips to position them on the timeline in a musical arrangement, usually within the boundaries of a short playback loop. Typically, drum sounds are duplicated and positioned to create rhythmic patterns; and vocal and instrument sounds are shifted on the timeline to ensure they are 'in time' with the music. To create some space for experimentation, the producer also frequently creates new temporary tracks so that clips can be dragged onto them to be set aside; layered with sounds on other tracks; or just manoeuvred more easily. Some simple edits are also required at this stage and the producer make use of editing tools such as 'resize', for cropping the start and end points of a clip.

Arranging with MIDI and VI

When arranging sounds created with a VI, the producer experiments with programming sequences of MIDI notes to trigger sounds using two main techniques.

- *Firstly*, by 'drawing' sequences of MIDI notes using the tools in the DAW 'piano roll' editor. Again, within the boundaries of a playback loop, the producer uses editing tools to draw, move, or lengthen/shorten notes, or simply delete unwanted notes to create a sequence. This experimentation is done in combination with pressing piano keys on the MIDI keyboard to 'light up' keys on the virtual keyboard to aid the location of notes on the piano roll in order to make edits (Figure 50).



Figure 50 - Using the Piano Roll editor in combination with the MIDI keyboard (inset: detail of the virtual keyboard, grid, and tool bar including the drawing tool).

- *Secondly*, by recording note sequences played on the piano keyboard in real time. Again, the producer sets up a playback loop and sets the DAW to record the inputted MIDI data to the VI track. Once captured, this data can then be edited using the piano roll in the DAW to edit each note's pitch, length, velocity (firmness of key touch), and timing (the temporal position of the note onset in time with music). Using these two main techniques, the producer sequences MIDI notes to trigger VI sounds, typically in small sections that in turn create short MIDI clips that can be arranged on the project timeline in the same manner as the audio clips.

Arranging the musical part using these methods is not necessarily a done as a discrete stand-alone task, but as part of a set of actions concerned with creating the musical parts and as such the musical arrangement may be refined and revised as each musical part is developed. These additional actions are described next, in no particular order.

Shaping and Treating the Sound

The use of raw sounds to construct musical parts is often accompanied with a requirement for treat sounds so that they sit together in the overall music-mix. To do this the producer employs several methods, often used in combination, which again requires the setup of a playback loop in order to facilitate critical listening and experimentation with the various tools at his disposal. These methods include:

- *Layering Sound* – which is done to blend the distinct components of sound and shape them into a new musical sound, for example the 'click' and 'thump' of a kick drum sound (see also chapter 5, pp 76). Layered sounds may also be grouped through a bus in order to apply treatments to the musical part as a whole, which in turn has the effect of cohering the component sounds together (see also treating sound below).
- *Shaping Sound* – in which editing tools may be used to shape the volume envelope of a sound (fade-in/fade-out). For example, a short fade-in may be used to soften the percussiveness of a drum sound, while a longer fade-in might be used to bring a sound effect to climax at certain point in the song.
- *Treating Sound* – which is done using a broad range of Digital Signal Processing (DSP) plug-ins that can be inserted in the virtual signal chain via the DAW mixer interface. This gives the affordance to apply treatment to individual layers of sound at the track level, or groups of sound at the bus level. DSP plug-ins include:
    - *Dynamic effects,* to automatically process sound volume in real-time;
    - *EQ, or equalisation*, to cut or boost the frequencies of a sound;
    - *Stereo effects*, to place sounds in the stereo field; *Distortion effects*, to colour the sound;
    - *Delay effects*, (echo or reverberation) to add perceived depth to sound.
- *Bouncing the part* – which involves uses the DAW 'bounce' or export functionality to render any layering, shaping, and treatment of sound to a new audio file. This rendering then replaces the original assemblage of sounds and effects to free up PC processing power.

In the process of shaping and treating sound, several plug-ins and their parameters might be called upon to find the right sound effect and/or the combination of effects in a signal chain. This can in turn create significant load on hardware processing resources leading to poor computer performance, often revealed as audio glitches or crashed applications. 'Bouncing' treated sounds reduces the CPU load and avoids disruptions to the flow of work, but also requires careful reasoning about whether the desired sound has been achieved before fixing audio effects and treatments; decisions which can be informed with referencing and analysing methods described next.

Referencing, Analysing, and Mixing Sound

A crucial set of methods in building the tune is the use of reference material (other music) and analysis tools to inform the process of creating, arranging, shaping and treating musical parts. These methods are used to address a range of concerns including incorporating musical trends; drawing musical inspiration; and emulating a style or genre of music, individual sounds, or musical arrangements. This might be done in two different ways:

- *Critical listening* – which is referencing in its simplest form and involves listening to music from personal collections or an online source (for example YouTube) to critically analyse and emulate rhythmic patterns, melodies, harmonies, instrumentation, and timbre (see Extract 16, pp. 131).
- *A/B'ing* – which is a referencing method for more detailed analysis, that involves setting up a playback loop in the DAW around the musical part being worked on (source A), and the musical feature of interest in the reference music (source B) imported to a separate track. Using the mute and solo functions, each source is alternately isolated for comparative listening, which is assisted with the use of analytical tools to inform the application of treatments (See Kick Drum example in Extract 17, pp. 132).

6.2.2 Building the Tune in Sections

Following the creation and layering of the main musical parts, the musical arrangement of the tune is expanded beyond short sequences of looped playback and is structured in sections (intro, verse, etc.). This involves copying and pasting entire assemblies of clips making up the musical parts along the DAW timeline so that they repeat without a playback loop, but further still, to arrange parts so they are brought into the music-mix at musically apt points in the tune (Figure 51).



Figure 51 - Expanding the arrangement of musical parts and clips along the DAW timeline

To summarise, this process involves attending to the following concerns:

- *Building the Intro* - The opening section of the tune is, as the producer put it, where each of the musical ideas are introduced. Musical parts are duplicated and arranged on the timeline so that they are gradually cued in, layer by layer, to build the introduction up to a climax.
- *Building the 'Drop'* – The 'drop' is the point at which the loud rhythmic and bass heavy elements of the song are instantaneously introduced for dramatic impact, or as the producer put it: going "from quite nice, to quite horrible, quite quickly". The drop follows the climax of the intro and requires a sharp transition in the musical arrangement and the addition of musical parts.
- *Creating Additional Musical Parts* - The procedures for building layers of sound are called upon as new parts are added to the musical arrangement. For example, a climactic buildup of sound effects and faster rhythmic patterns are added to the introduction to foreshadow the 'drop', after which musical parts might be added or rearranged into new drum patterns and bass lines to make up the composition.

The methods summarised above are a gloss on the activities concerned with building sections of the tune, which is intentional as they essentially amount to an expansion of the methods for creating the musical parts. For example, the methods for arranging individual sounds or notes into musical parts, copying, pasting etc., are extended to include assembling those musical parts into a section of the tune. Furthermore, building the tune in sections is not done as a discrete stage of the process but as part of an iterative process that calls upon the methods that we have explored so far for example creating musical parts.

6.2.3 Uses of Metadata in Creating the Tune

In some of the tune creation activities summarised above, metadata is typically used to search or browse for resources to bring in to the process, such as sound files or reference materials, however beyond this much of what we might recognise as 'metadata work' to organise the process is largely abandoned. The job of musically arranging, layering, shaping, and treating of sound, is instead facilitated through graphical representations of musical data, such as audio clips, MIDI notes, and readings of analytical tools; and the relationships of these data as they are mapped two-dimensionally in layers of sound on the DAW's compositional timeline (see again Figure 51). Although these processual resources and their characteristics might bear resemblances to metadata (as information that represents data, and accounts for relationships of data), the description of their methodical uses are included here tentatively, as previously done in Chapter 5. Nonetheless, as a study of contemporary music production these descriptions are of interest and so the following sections explore these methods in further detail, without any premise of these methods necessarily being 'metadata work'.

Drawing on the Local Sound Library

As we have already explored, the producer's organisation of the local sound library provides for the process of creating musical parts, through both structuring of a file system and the generation and addition of musical metadata (pitch and tempo) to the file names. This is demonstrated in Extract 15 below.

Extract 15 – Auditioning and importing sounds

The producer has mostly completed layering parts for the tune's intro and is adding some sound effects to emphasise a climactic build up (see Building the Tune in Sections, pp.127). To do this he browses and retrieves sounds from a file folder named 'FX I ALWAYS USE'.

Steve: [listens to the introduction; stops playback near the end] right, let's work on the build-up next [minimises the DAW window, closes an open explorer window] (sighs) told you it's boring [eyes scan desktop for a folder; clicks on 'FX I ALWAYS USE' folder to open an explorer window to view contained files]

//transcript abridged//

Steve: [begins auditioning sounds: clicking on a file in the folder to open and audition the sound in media player (Figure 52)]
(inaudible) Want one of them in there (that will go) in the effects section, quickly.
[drags file to a new DAW track; creates a new bus and routes all new tracks to it, names bus 'fx'; starts playback; duplicates the sound effect clip and drags to position later in the timeline; stops playback]



Figure 52 - Auditioning sound files.
(low resolution image from video data)

This example neatly demonstrates how the customised organisation of the local library provides for the process, as the producer is able to locate quickly a set of sound effects (in the FX I ALWAYS USE folder) that have already been auditioned and used in other tunes and set aside for reuse. We also observe the character of the ongoing organisation of audio in the process: note that custom labelling of the new tracks is deferred as an unnecessary overhead of work, but are mapped to a bus, labelled 'fx', in order to retain group control of the sound effects in the mix. There are two observations that can account for this.

- *Firstly*, on importing the DAW, the clips and tracks are automatically labelled with file names, which is sufficient to distinguish them in the ensuing arrangement and shaping of the sounds;
- *Secondly*, sounds are often discarded in the course of experimentation and so customised labelling of tracks at this point in the process is potentially effort wasted.

To provide for the task at hand then, there is a sufficiency in both the default metadata that propagates through the transfer of audio data to the DAW, and the custom labelling of audio grouping in the DAW environment, hence any detailed 'metadata work' is largely overlooked at this point in the process.

Referencing Musical Arrangements

Reference material can be used in the process to invoke some musical inspiration in the creation and arrangement of new musical parts. In the extract below this is demonstrated as the producer (Steve) retrieves music from an online source (YouTube) in order to emulate its rhythmic drum pattern.

Extract 16 – Referencing musical ideas in arranging a musical part

The partially constructed introduction to the tune is playing back looped in the DAW and the producer (Steve) is experimenting with triggering VI synthesiser sounds from the MIDI keyboard to create a new drum part for the tune. In order to help this process, he turns to existing music to get some ideas.

Steve: Just trying to think of a film that would have that… …that kind of… …that feel to it. I think like maybe inc… inception or [opens internet browser with Google search page] or what's the one, the Tom Cruise one? Erm…

Glenn: Not Minority Report, No?

Steve: M83 did the (music)

Glenn: Oh yeah?

Steve: [Types 'm83 Tom Cruise' into Google search and hits enter; top results are returned] Oblivion! That's it.

Steve: [Searches YouTube for 'Oblivion opening music'; opens a video from the search results; listens to playback for a few seconds; clicks on time bar to skips to later in the song]

Steve: [Plays a few notes on the MIDI keyboard along to the music; stops playback] hmm, not quite the bit I was looking for but not far off.

Steve: [Clicks to open the DAW and begin playback; plays MIDI notes along to the music; uses the editing tools to draw in MIDI notes to the timeline, while using the MIDI keyboard to find correct pitch for the drum sound (Figure 53)].

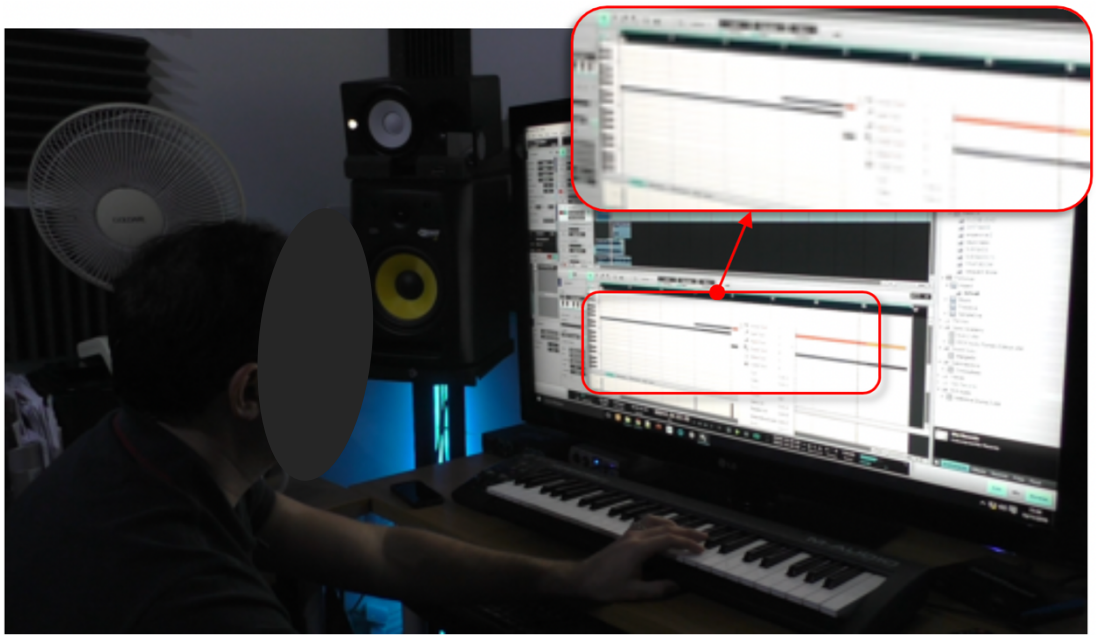


Figure 53 -Drawing MIDI notes (bottom of screen) to the timeline using keyboard to find correct pitches. (low resolution image from video data)

After several minutes of arranging the MIDI part in the DAW, Steve switches to creating the part from an audio clip of a drum sound.

Steve: [opens the internet browser to starts playback of the Oblivion opening music; taps the drum rhythm on the desk with a finger along to the music] dum - dum - dudu dum - dum dum dum.

Steve: [Opens DAW, arranges copies of the audio clips on the timeline].
Glenn: Are you trying to get the right (drum) pattern?
Steve: Yeah, kind of like I say, a similar kind of thing [continues arranging clips into a drum pattern using timeline tools] (Figure 54)].



Figure 54 –Arranging clips into a drum pattern using copy, paste, and trim editing tools (low resolution image from video data)

This example demonstrates an interesting feature of the producer's methods: the ad hoc layering of sound between two software platforms. In this case sounds in the DAW are layered over media hosted online and played back through a web browser. We also observe this method in the auditioning process for creating musical parts as audio files are auditioned using the PC's native media player layered over looped playback of the partially completed tune in the DAW (see pp. 123 and 129). To the more technically conversant there are clearly metadata at play in these activities, information searches rely on metadata to work whether on a local system or online, however this is largely hidden from view. While this might sit outside of our focus on direct methodical uses of metadata, this work practice does touch upon technical metadata concerns surrounding interoperability of data in cross-platform working, the prospect for which can be observed in more detail in the following example.

Referencing Using 'A/Bing' Technique

Reference material is also used to critically compare and analyse musical parts as they are created using a technique called *'A/Bing'*. This technique is also used to check and refine the balance of sounds in the overall music mix, as musical parts are added and the composition builds. Mixing the music 'on-the-fly' while developing the tune enables the producer to check whether a musical part is effective in complimenting or contrasting with other musical parts in the song as demonstrated in Extract 17 below.

Extract 17 - A/Bing a Kick Drum using Spectrum Analyser

The producer (Steve) uses is working on creating and shaping a kick drum part and is 'A/Bing' with clip taken from a reference tune. He has set up a playback loop that plays his kick drum sample and the reference sample in sequence and is comparing the sounds using a frequency spectrum analyser.

Steve: Oh, I think I know what's going wrong... His (reference kick drum sound) and mine are both hitting in the same place… here [points to peak in spectrum analysis curve] … F is somewhere round here I guess, something like 47Hz, and his… the bass is kicking there, really.

Steve: [Clicks a button on the analyser in time to memorise freq. analysis of reference kick drum; Clicks a button on the analyser in time to memorise freq. analysis of new kick drum to seond memory slot] (Figure 55)

Steve: See that there [hovers cursor over low frequency portion of the spectrum curve] mine just needs to EQ that out a little bit.

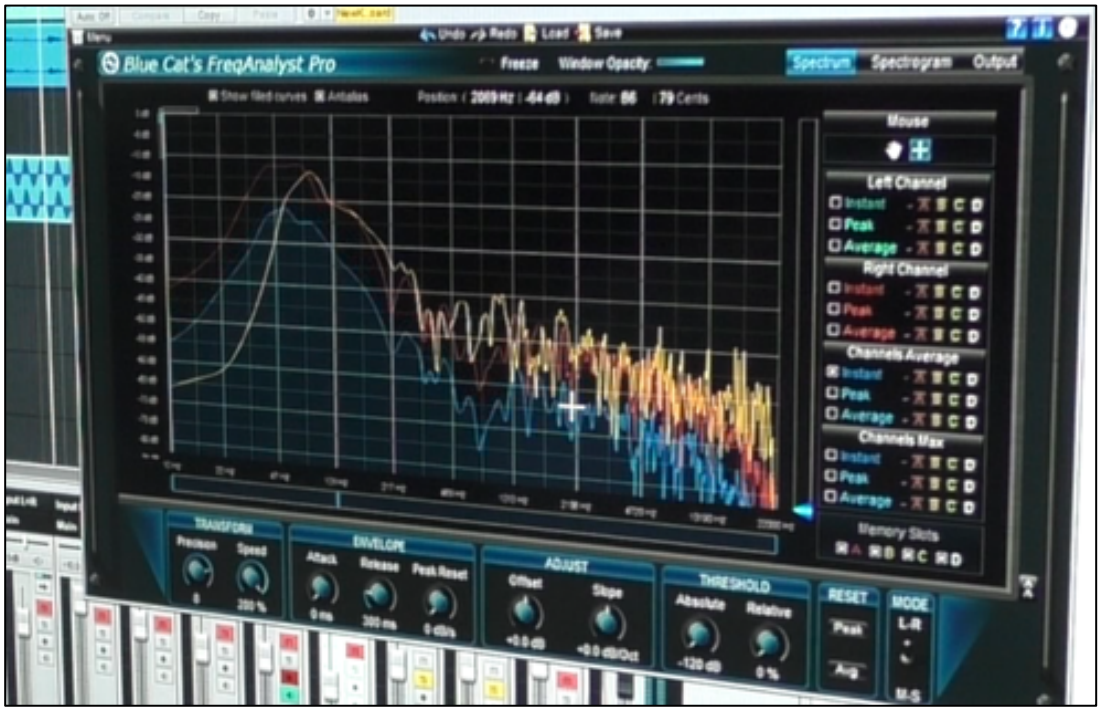


Figure 55 - A/Bing and analysing frequency spectrum

This example demonstrates the kinds of visual representations of audio data that are drawn upon in the production process, which are again tentatively included here as metadata work. The spectrum analyser used in the referencing activity above breaks down sounds into their composite audio frequencies and displays their relative strengths in a graph. These graphical analyses provide representative information about the properties of the underlying audio, in short data about data, which provides the producer with a resource to visually correlate his critical listening and make decisions about the shaping and treatment of sound: in this case the equalizing the bass frequencies of the kick drum sound

6.2.4 Summary of Creating the 'Tune'

Creating the tune is an extensive activity in which the composition of sounds iteratively evolves in the DAW through the application of several methods that are aimed toward addressing two key concerns. *Firstly*, to create musical parts from a local library of audio files or experimenting with VI's, both of which are subjected to an auditioning process to find suitable sounds. Parts are musically arranged in the DAW in short playback loops of musical phrases or rhythms through experimentation with the placement of either audio clips or MIDI note data on timeline, sometimes drawing upon other music for inspiration. The sound of a musical part can be shaped by layering and blending sound; editing clips, for example trimming and fading; or treating sound with DSP processors and effects. Sounds are evaluated and analysed using an 'A/Bing' technique for comparing the sound (source A) to reference material (source B), which aids critical listening, analysis and treatments of sound. Finally, to preserve computer processing power sounds are 'bounced' which renders treatments permanently to a sound file. These short loops are layered with other parts to build up the composition of complimentary musical elements making up the overall musical arrangement. *Secondly*, to build the tune in sections, which involves using copy and paste functions to arrange the layers of musical parts beyond short playback loops and into introduction or verses, for example. This requires calling upon the methods summarized above to continually develop musical ideas; add new musical parts such as sound effects to build up to climactic points in the tune and the shaping and treating sounds and the overall music mix, to incrementally bring the song to completion.

About the Metadata

The role of metadata in this process includes drawing on the local sound library to search for, retrieve, and reuse sound to create musical parts, using extra information added to audio file names and the custom organisation of files and folders, as described in the previous section. The metadata in the audio file names propagate through the process as they are automatically applied to track and audio clips labels when importing audio files to the DAW timeline. These labels are not updated to bring about organisation to the assembly of sounds in the DAW, as might be expected, because in the process of editing, shaping, and treating sound to render a musical part, the original audio files are often discarded as a by-product of the process. The organisational resources used instead are the visual and graphic affordances of the DAW that enable representations of elements of the composition (sound clips and MIDI notes) to be arranged within the two-dimensional virtual space that maps sound layers to a timeline; and the graphical representations of sound generated by some analytical tools. Some labelling is applied to groups of audio, or busses, used to organise the overall music-mix which in turn provides efficacy to the flow of work in creating the tune. Further labelling and organisation of sounds are deferred until later in the process

when the musical elements and the metadata can be reconstituted to provide for the work in the final mix-down stage of the process.

6.3 FINAL MIX-DOWN AND MASTERING



Figure 56 - The final mix-down and mastering process

In this stage of the production, completed tunes go through a final mix-down and mastering process which aims to test and critically evaluate the tune, refine the music mix and optimise the loudness and fidelity of the song with some final signal processing. The process summarised in Figure 56 and below:

- *Testing the rough mix (the car test)* – involves critically evaluating the mix on a consumer sound system, for example a car stereo. This is an outlying activity not directly observed.
- *Preparing the mix-down* – involves reorganising the layers of sound into 'stems' or single audio tracks that are rendered from sub-mixes of the musical parts.
- *Doing the mix-down* – involves balancing the volume level of the 'stems' in the music mix and applying a variety of treatments and includes the use of reference material for comparison of treatments.
- *Mastering* – involves applying some final treatments to the tune in order to optimise its loudness, ready to be played on a club sound system. As above, this includes the use of reference material for comparison of treatments.
- *Testing the Master (the club test)* – involves critically evaluating the mastered mixes on a club sound system as part of a DJ performance. Again, this is an outlying activity not directly observed.

This section describes how these activities are accomplished, including descriptions of the two outlying testing activities, testing the rough mix and testing the mastered mix, that although were not part of the observed activities nonetheless contribute to explicating much about the producer's working practices.

6.3.1 Testing the Rough Mix (The Car Test)

Many of the mixing activities are integrated in the tune creation process through the shaping, evaluating, and treatment of sound detailed in the previous section and so once a tune is completed much of the mixing work has been done to at least a rough standard. In order to evaluate the rough mix, the tune is exported to a portable format that can be played back and appraised on a sound system outside of the studio that the end consumer might use. Common practice is to do this on a car stereo, hence *the car test* as mentioned in Extract 18 below.

Extract 18 - The Car Test

The producer (Steve) is in his home studio and has a DAW session open ready to begin mixing down the stems of a completed tune. He explains his progress so far in the mixing stage.

Glenn: OK, so what have we got here then? (referring to song loaded in the DAW) you've got all the stems ready to mix?

Steve: Yeah, because generally I do mix as I go along (creating the song) most of the time as you've seen before, but this one I did the car test yesterday morning and it was alright, it's just making sure everything is in the right place.

Here the producer indicates that an integral part of his work practice is 'doing the car test' to critically evaluate roughly mixed tunes on a car stereo before starting the final mix-down work. This process presumably informs further development of the tune if necessary, however in this case the arrangement and the mix of musical parts are appraised to be satisfactory and so the tune is prepared for the final mix-down.

6.3.2 Preparing the Mix-Down

The mix-down observed in this study uses an approach termed as a 'stems mix', in which musical parts are bounced to single mono or stereo tracks to render any layering, processing and effects applied in the tune creation stage. This consolidates the musical parts to reduce the complexity of their constituent layers and renders any treatments to free up computer processing power, but still provides the flexibility to further refine the balance of musical parts. To prepare the tune for mixing then, the DAW is used to prepare and export 'stems' from the composition; assemble stems in a new project file alongside other reference material; and setting up the DAW project with analytical tools similar to preparations for creating the tune (see pp. 120).

6.3.3 Doing the Mix-down

Doing the mix-down involves more refined instances of many of the activities that have been detailed in the tune creation, as producers typically "mix as I go along" in this type of music production (see Extract 18 above). The mixing process then includes methods for referencing (A/Bing), analysing, and balancing the mix of sounds; and shaping and treating sounds, which are applied to individual layers of sound and to the overall music-mix. Further to this mixing also involves sound replacement if treatments are not effective in fitting sounds into the mix, in which case the methods for creating musical parts are called upon to replace sounds altogether.

6.3.4 Mastering

Following the mix-down, a version of the tune is exported to a single audio file which is transferred to a different DAW platform for mastering. This process again involves referencing (A/Bing), analysing, and applying treatments in order to optimise the loudness and fidelity of the mix, and to balance the audio frequencies. Any issues that cannot be fixed with treatments in the mastering stage, such as a musical part that is too loud or too quiet, reverts the process back to the mix-down stage to fix the problem and a new version of the mix exported and transformed to the mastering DAW platform. Any previous iterations of the mix might also be included alongside reference materials, in order to do a comparative analysis and evaluate the effectiveness of any fixes or treatments.

6.3.5 Testing the Mastered Mix

In this study the tunes are specifically produced for DJ performances in a club environment and as such are required to be optimised for loudness, in order to compete with tunes of the same genre produced by other labels. To test how the tunes sound on a club sound system, the newly completed tunes are integrated into DJ performances to inform the effectiveness of the mix-down and mastering process. This is in contrast to the conventional process in which mastering, usually done by a specialist engineer, is the final stage of music production prior to release for general distribution. Allowing audiences to hear tunes before their release, however, is crucial to the producer's process to the extent that the mix-down and mastering activities are scheduled around his DJ performances, as he states: "I try and do mix-downs before the weekend, so we can test them out (in a club)". This allows for gauging audience reactions to new music and evaluating the effectiveness of mixing and mastering treatments applied specifically for playback on a club sound system. (Note: the producer has previously enjoyed commercial success which consequently required tunes to be professionally mastered for radio air play. This mastering did not successfully translate to playback

on a club sound system, however, and so the producer has since done all his own mastering.)

6.3.6 Uses of Metadata in Final Mix-Down and Mastering

As described in the section Creating the Tune, the focus of the work is to assemble and shape sounds into a tune, which can result in a haphazard composition of audio clips and MIDI data. Any semblance of order is brought about through the use of busses to group layers of sounds in order to simplify the ongoing concern with attending to the overall music mix. In the meantime, organisational methods such as labelling, and ordering layers and compositional elements are largely abandoned in the process of the experimentation with sound, a task which is deferred to the final mix-down stage of the process. In the following sections we explore the creation and uses of metadata in the transition to this stage of the process, which includes the reorganisation and labelling of sound layers into 'stems'; the use of visual representations of sound; and the versioning of mixes and masters as changes are made iteratively.

Reorganising the Composition of Sounds

To prepare the mix-down, musical parts are 'bounced' in the DAW to a new audio file, to consolidate its composite layers of sound and treatments. These are reorganised and labelled in a new DAW project in preparation for the mix (Figure 57).



Figure 57 – The imported stems ready to mix, note each track is a continuous file

Table 8 -The track labels for each of the stems.

TRACK LABEL	MUSICAL PART
21-noisia-oh_oh(original) [vision_recordings]	Reference Tune
Ds	Drums
Ds 3	Drums
Perc	Percussion
Ds 2	Drums
End of bar eds2	Drum Roll (end of bar edits)
Fx1	Effects
Fx1 3	Effects
Fx1 2	Effects
Fx 2	Effects
Intro	Intro Effect
Lead1	Synthesiser
Lead1 2	Synthesiser
Mian bass *(sic)*	Main Bass
Mian bass2 *(sic)*	Main Bass
Plonk	Synthesiser
Sub	Sub bass
Voc	Vocal part

Table 8 shows the ordering and application of track labels to each of the stems in the newly created project, which provides for the navigation of sound layers in the DAW during the mix-down process. Notably, there is no longer a need to use busses in this configuration as stems are effectively sub-mixes of musical parts that include the balancing of composite layers and sound treatments applied in the tune creation stage. This reorganisation in turn provides for the mix-down process by preserving the work done in the tune creation stage, while significantly reducing the complexity of the musical composition and therefore the work required refine the overall music-mix. The mix-down and mastering stage is further provided for with the addition of analytical tools and reference materials in the DAW, which are resources that are methodically used for critical listening and analysis explored in the next section.

Drawing on Visual Representations of Sound

As we have observed earlier in this study, visual representations of sound are a key resource in the production process, particularly the graphical information generated by analytical tools from real-time playback of the tune in the DAW. These visual representations are used extensively in the mix-down and mastering process to correlate with the detailed critical listening required to inform the shaping and treatment of sound. For example:

- *Spectrum analysers* enable the visualisation of how sounds fit together within the audible frequency spectrum. This can inform treatments to equalise and restrict a musical part to a of frequencies, in order to optimise its presence in the mix while leaving space for other musical parts (Figure 58).

- *Loudness meters* enable the assessment of the true loudness of the mix (which does not always correlate to peak volume indicated by level meters). This is crucial in order to create for impact in the club environment where tunes compete against other artist's tracks.
- *Phase correlation meters* alert to the potential for signals in the left and right stereo audio channels to cancel out when mixed together on a mono sound system, which are typically installed in clubs.
- *Mono/stereo mix analysers*, used in critical listening to switch from a stereo mix to mono mix, to assess if any sound is lost due to phase difference (see above).
- *Mid/Side analysers*, used to analyse 'side' or the exclusivity of audio information in the left or right audio channels. While can be produce pleasant stereo effects on a hi-fi system, too much side information in a mix can be problematic for music played on club sound systems as placement of speakers can be unpredictable. For example, if left and right audio channels are fed to separate parts of the club, listeners can lose part of the music mix.



Figure 58 - Using frequency analysis tools

These graphical representations and readings are a crucial in informing the treatment of the mix using digital signal processing (DSP) such as EQ, or dynamic gain controls, to balance and shape individual sounds. This involves doing A/B analysis to compare the stems mix to the reference material paying particular attention to the frequency analysis and loudness. Using this method, the producer homes in on particular sounds (Figure 58) that create clashes with other sounds or are producing problem frequencies that need to be fixed with some processing or editing. This process of critical listening, analysis, and treatment continues until refinements to the mix are complete and a version of the mix is exported for mastering, which essentially applies the same methods to the overall music mix instead of the individual stems.

Versioning of Mixes and Masters

The transition between the mixing and mastering process requires exporting the mixed tune from the DAW to an audio file, which is then imported to a different DAW platform for further analysis to verify the mix-down and add further treatments. This may be done several times should any problems found that require reversion to the mix-down stage to do further work to the mix. Attending to version control by appending version numbers to file names is crucial to this transition and further still, to the mastering process itself as iterations of the mix are retained and any changes to the mix, even subtle ones, are verified against the previous version using A/Bing techniques.

6.3.7 Summary of Final Mix-Down and Mastering

Mixing and Mastering involves detailed refinement to the overall music mix of the song and application of treatments to optimise the loudness and spectral characteristics of the song in comparison to other music that is likely to be used in similar DJ performances. This involves reorganising the composition from a situated and complex arrangement of largely unlabelled audio clips, to an aggregation of musical parts arranged and labelled up in layers of sound known as ‘stems’. This brings about a more simplified and formal organisation to components of the tune, which provides for navigating the sound layers in the DAW ready for verifying and refining the mix. This involves A/Bing to analyse the loudness and balance of musical parts, and their spectral characteristic in comparison to a reference song; treating and balancing sound using DSP’s as informed by the analysis; and saving and exporting a mix version to an audio file. The mix is then imported to a mastering DAW platform in order to add final treatments that optimise loudness and equalise the frequency characteristics informed by A/Bing methods to compare the mix to a reference song. Any problems with the mix that cannot be fixed with treatments means that the process reverts to the mix-down to fix problems and produce another version of the mix which is then processed as before.

About the Metadata

Observed uses of metadata include labelling the stem files to organise the aggregated sound layers into musical parts; drawing on stems labelling to reassemble the song and to navigate the layers of sound; use of visual representations of sound in the analysis of sound; and use of file names to track versions of the mix. In verifying and refining the mix, the producer draws on the reorganisation of audio to navigate sounds for analysing, treating, balancing, and editing sounds. A corresponding version number is appended to the exported mixes and the DAW project files, to organise iterations of the mix for each time the process reverts to the mix-down stage.

6.4 SUMMARY OF A STUDY OF HOME STUDIO RECORDING

In this study, a professional electronic music producer is observed working alone to create music in a complete end-to-end process using a DAW workstation. The analysis shows several methods at play, which include using DAW software to: assemble songs from sounds in a local library and sounds created using virtual instrument (VI) software; experiment, blend and shape individual elements of sound; apply treatments to individual and groups of sounds; and to analyse reference material to compare and shape both individual sounds and the overall music-mix. These methods are used and reused in three main stages of the production process: preparation and setup, creating the tune, and final mix-down and mastering. Excepting preparation and setup, the overall process is highly iterative, as production activities are sequenced several times over in each stage.

About the Metadata

This iterative flow of work tends to obscure the discreteness of these activities in the process, nonetheless the role of metadata can be explicated, principally in the propagation of file names throughout the process and organisation of audio in the DAW, for example in preparation for use, the producer appends file names with coded key signature and tempo information using analytical software, in order to make sounds searchable. File names are applied to audio tracks by default, as the sound files are imported and assembled in the DAW, however the producer seldom updates these track names, as the process of experimentation with sound to shape and produce new sounds is ephemeral in character resulting in by-products that are eventually discarded. Organisation is instead brought about in setting up the DAW to provide for song creation with audio channels and DSPs that support the process and “get the vibe going”. Graphical representations of sound are used frequently in the process to shape sound. Finally, this metadata work features again in the transition from song creation to mixing, in which the producer consolidates, reorganises and labels the layers of sound to stems that are used to simplify the mixing and mastering process.

Chapter 7
A Study of Project Studio Production

This chapter presents the findings from a study of project studio production in which a producer works to reorganise and mix a client's demo song that has been handed over to him for development as part of a musical project. The findings begin by setting up the background and context of the collaborative and the producer's role within the project. The substance of the findings is in the description of the 'client mix' and the methods that the producer employs to unpick the artist's composition created in the DAW and to reorganise the audio elements to provide for potential future production work.

Introduction

Project studios are commonly set up for the one-off needs of a particular musical project, or the ongoing needs of individual and/or group of collaborating artists and producers. Like home studios, a project studio may be built to give the affordance of comparatively lower overheads in studio expenses and greater availability of time for creative music-making activities. In contrast, recording studios are commonly hired by the hour to capture performances and only after song creation has been done elsewhere. Project studios are typically less well equipped than recording studios, but larger than a home studio and so enables a reasonably broad range of production activities within the space, including recording live instruments. The location for the study is in one such project studio built in a business unit, which is managed by a community of music practitioners for their own and other collaborator's production needs. The studio space is centred on a DAW workstation and monitor speakers and although is sparsely equipped, sufficiently supports music production activities of its user from end to end including composition; recording a variety of instruments; and mixing and mastering music.

The study observes a professional producer using the studio to mix a demo song composed by a collaborating artist as part of a project to produce four songs into an 'EP' (Extended Play record). The artist creates the demo music remotely using DAW software before handing the song data over to the producer to developed into the final song. Although the artist and producer use compatible DAW platforms, which eases the exchange of musical data, tensions occur elsewhere in the organisation of the compositional elements of the song (or lack of), which seemingly overlooks the need

for the musical data to be reused in later processes. This results in significant work overheads for the producer to un-pick the artist's composition on hand-over and create new metadata to reorganise the composition in preparation for future production processes.

7.1 THE FINDINGS

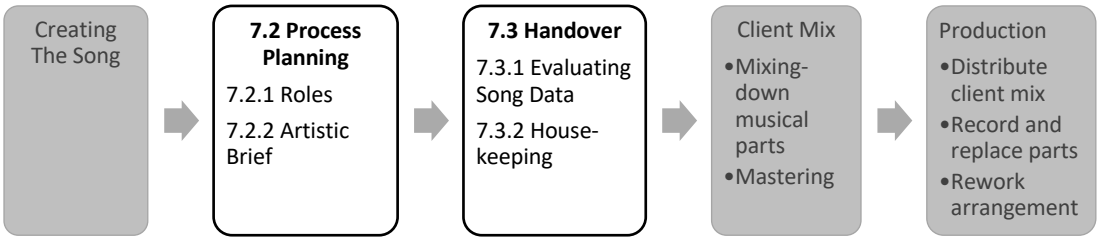


Figure 59 - The collaborative process, as derived from the producer's explanation

The study observes a studio session in which the producer performed what he termed as a 'client mix' of the artists demo compositions as part of a broader collaborative process to create and develop songs, as summarised in Figure 59 and below:

- *Creating a Demo Song* – the collaborating artist creates songs, presumably in a home studio using DAW software (outlying activity not directly observed);
- *Process Planning* – involves planning the production activities and setting out roles (again, this is an outlying activity not directly observed);
- *Handover* – this involves evaluating and reorganising (housekeeping) song data in order to provide for future steps in the production process,
- *Client Mix* – this involves doing a high-quality mix-down and master of the song.
- *Production* – this stage is assumed from the accounts of the producer's plans. Songs are developed in what the producer termed as a 'recursive' process, meaning the demo is developed in a piecemeal fashion by recording and replacing musical parts and reworking the musical arrangement.

In the following sections we briefly explore production planning, as accounted for in the producer's preliminary explanation of the project; and the handover of musical data as accounted for in the direct observations of studio activities. Note: the final part of the client mix, the mix-down itself, is summarised briefly here as an example of a mix-down is provided in the previous chapter. Instead the main focus of the findings is in the unique features offered in this study scenario, namely the distributed collaboration between the artist and the producer and work required to resolve the tensions that occur in the handover of musical data between parties and stages of the process.

As in the preceding study chapters, the descriptions of activities in each stages are necessarily glossed over in certain aspects, as this kind of production work involves highly detailed and technical understandings of the treatment of sound, which again has the potential to draw our interest away from our focus on the *social character* of the work and the role of production information used in the process. Following the descriptions of the activities then, is an exploration of the *methodological uses* of production metadata used and created in the process. In order for the reader to gain some appreciation of the kinds of metadata at play in the recording engineer's work, these descriptions are supplemented with figures and vignettes extracted from transcriptions of the video field data.

7.2 PROCESS PLANNING

This stage of the process involves collaboration between potential stakeholders to plan the production activities. In this case of this study, the producer visited the artist at his home to listen to the songs and to discuss the possible plans for the musical project centred on two key concerns: the producer's role, and the artistic brief.

7.2.1 Determining Roles

As discussed briefly in Chapter 2, the roles of actors in modern music production turn upon the range of different music-making scenarios and approaches opened up by digital technology. These roles range from sole artists independently creating music end-to-end (as in the Home Studio study); through to the traditional roles of, for example, engineers, producers, and artists in the recording studio; and any combination of those roles in between. In this study the principal roles are split nominally between the 'artist' and the 'producer' (Mark), as explained in Extract 19

Extract 19 -Discussing the Producer's Role in the Project

Mark: When we discussed (the study scenario) it was kind of look I've got this guy (the artist) and he wants me to do the mastering and the mixing and he's been producing… …I said to him I can do you a deal, I'll give you 'X' price for daily rate mixing, and I'll give you another price and you give me a percent split on the profits of anything you make on it, so that's mix production. But it's gone on from that to the point where we've discussed melodic alterations and arrangement alterations, so now it's a potential full production of a royalty split on the song writing itself. So, it's kind of escalating to that.

This extract demonstrates the variability of roles in modern music production: Mark's originally intended role was to mix and master songs that the artist had written, performed, and produced, but developed through discussion to include a prospective role in song writing, musical arrangement, and production. Given that some of the responsibilities overlap then, the demarcation of roles might seem relatively nominal, nonetheless in this scenario at least the weight of the artistic effort remains with the 'artist' while the production responsibilities lie with the 'producer'.

7.2.2 The Artistic Brief

The collaborative relationship between the artist and producer turns upon developing an artistic brief in the planning stage of the process, which provides for proper planning of production activities. In

Extract 20 below, the producer (Mark) discusses his conversations with the artist on the subject of the artistic intent of the project.

Extract 20 -Discussing the Artistic Brief

Mark: What I can say is, what my most important question to him was, who is it important that we *don't* sound like, because that's the really incisive question for me… …Erm, what transpired was that one of the people who it's really really important *not* to sound like is Faithless, cos it's going to get levelled (compared). We discussed the collaborative thing because I've got quite a lot of connections in Leicester now and he was already moving down this alley, so (we said) why don't you have Chris and Shanice and why don't you guest with some of Leicester's finest, there's some awesome talent down there and he's going, that's kind of where I was going.

This extract demonstrates how the artistic brief provides for forming a production plan. For example, the prospect of inviting other artists to contribute to the songs with guest performances shapes process itself, as this necessitates the need for the 'client mix', in order to garner interest from these potential collaborators. Further, the brief informs the choice of reference material, or songs used for comparison in analysing the overall music-mix, as will be observed in the next sections.

To summarise: Process planning is a collaborative activity that is key to successful project initiation that allows parties to set out artistic aims, roles, and project requirements. In the scenario outlined above, this is perhaps distinct from what might traditionally be considered pre-production; the original intent of the discussion was to garner the producer's services in mixing and mastering, a distinctly post-production activity. The outcome of the discussion, however, set out aims for a reiteration of production activities to progressively develop the songs, for which the client mix serves two purposes: as both a 'post-production' activity to conclude the production implemented by the artist; and as a 'pre-production' activity to transition into the next round of production activities.

7.3 HANDOVER

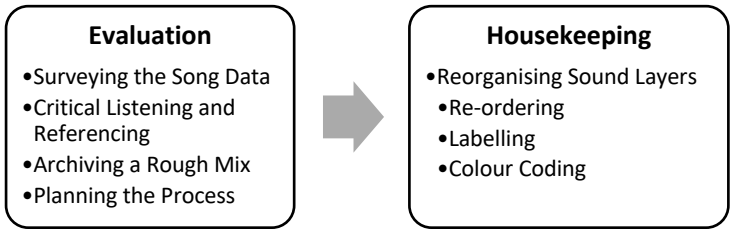


Figure 60 - The Client Mix Process

Managing the handover of musical data involves the process shown in Figure 60 and summarised as follows:

- *Evaluation* – which involves the musical and technical evaluation of the composition of song data in the DAW, and preparation of processual resources;
- *Housekeeping* – which involves reorganising the composition of song data in the DAW

These activities provide for doing the client mix, which in combination with the activities above, aims address two main concerns: *Firstly* so that the producer can deconstruct and become familiar with the artist's compositions and identify musical elements requiring development; and *Secondly*, to distribute demos of the songs that are mixed to a high standard in order to 'create a vibe' and garner the interest of potential collaborators, including singers and musicians.

7.3.1 A) Evaluation

A part of collaborative music production involves the exchange of musical data including multi-track audio, and DAW project files containing complete or partially assembled compositions. This handover requires the recipient to evaluate song data in order to inform the next steps in the process, which involves the following activities:

Surveying the Song Data

Surveying the song data involves assessing the technical and artistic features of the musical composition to inform the client mix procedure. For example, a technical assessment might include anticipating compatibility issues between DAW platforms, or the types and configurations of musical data present that may affect the flow of work (in this case mix automation data). An artistic assessment might involve, for example a listen through of the song and a survey of the composition in the DAW to make sense of the layers and arrangements of audio.

Critical Listening and Referencing

Reference songs, or music that has already been mixed and mastered, are used for critical comparison throughout the production process. This is done for two main reasons.

- *Firstly*, audio frequencies can be reproduced unevenly dependent on the system used and the shape and acoustic treatments of the room, which can be further compounded by the listener's subjective perception of sound. Listening to reference songs 'calibrate' hearing ("getting my ear in" as the producer put it) for more comparative and objective listening, particularly surrounding the balance of audio frequencies.
- *Secondly,* the ears can become fatigued from prolonged listening and so the accuracy of judgements on how to treat sound can deteriorate with time. Referencing methods can assist in making accurate production decisions, not only through assisting critical listening, as above, but also through the use of DSP tools to make comparative analyses.

As part of the preparations in handover, reference songs are gathered and added to tracks in the DAW project to provide resources for various parts of the process in which referencing is used, including in the creation of a rough mix in the initial handover.

Archiving a Rough Mix

Previous iterations of the song under production are used as reference material at certain key points in the production process and in the handover activity, a rough mix of the song is exported to an audio file be drawn upon later in the process. Creating the archive itself also involves referencing using a method known as 'A/B'ing' that involves switching between playback of the song in production (source A) and a reference song (source B) in order to do comparative critical listening and analysis. This method is used alongside analytical tools to inform the application of treatments to the rough mix that make the music sound louder, as if it had been mastered, in order to represent the final product more closely (Figure 61).



Figure 61 - Using frequency spectrum analysers (left) and a sound level limiter (right) to prepare the reference mix.

In turn, this provides an archive of the song in its state of development at the time of hand-over, for referencing the artist's original intent for the song and to monitor progress in comparison with the ongoing production work.

Planning the Process

As a result of the evaluation activities above, an ad hoc process is formed of contingent tasks that are aimed toward addressing any arising concerns. For example, in this study, the cursory assessment of song data, and creation of the rough mix highlights the disorganisation of the audio composition in the DAW and the significant overhead in work to reorganise that data to prepare for a new orientation of work.

7.3.1 B) Uses of Metadata in Evaluation

Compatibility of Data and Flows of Work

The evaluation of song data inevitably highlights potential troubles that need to be overcome in order to progress the process. For example, the ways in which DAW software packages the composition of sound and musical data are not always fully compatible across platforms. In Extract 25 below, the producer (Mark) opens the song project file in the DAW and talks through his concerns surrounding the handed over project data while surveying the data

Extract 21 – Surveying the Data

Mark: So we're starting with a raw project, which is I think they've been doing it… …some of them are Garageband (project files) they've certainly got 'dot band' (.band file extension) and some of them aren't Garageband files that are coming across, I'm not sure what he's working on but he showed me Logic on his laptop, it doesn't matter [opens DAW on the PC]

Mark: So this particular one has had some mixing done on it and he's got plug-ins on it, and he's he's got some automation on it… …What's concerning me is that I want to move fast and efficiently and I don't want to redo lots of things that are already done… but… automation is a nightmare.

…

Mark: I'm going to make a decision about what automation I'm going to switch off or not… erm so my immediate question is, and this is not uncommon taking over peoples projects like this, is what's the best way, time effectively which is (also) cost effectively, but artistically and technically (to proceed).

What this extract shows is that the seemingly insignificant detail of the project file extension displays an account of how musical data has been created and packaged for handover, which in turn has anticipated effects on the process. Compatibility of the data is not an issue in the example above but is anticipated to cause issues for musical data handed over for other songs. Further evaluation of the musical data also displays an account of the working methods in the previous stage, which in this case is the use of automation for mixing that is in turn anticipated as incompatible to the producers preferred methods of working.

Abandonment of Metadata

Similarly, the lack of processual information can cause significant overheads in work to reconstruct and restore. In Extract 30 below, the producer (Mark) has completed critical listening activities and reasons about the next steps in the process, beginning with addressing the seeming lack of organisation to the musical data.

Extract 22 -Assessing the project composition and mix, planning next actions

Mark: [stops playback] Right, I'm just going to … I think what the next step is and I just need to be clear about this before I… because there's a potentially big workload implication in how I go about this next step.

…

Mark: So that's a two-step process, the first is I've got to label all the crap. I'm going to move things around so I know where they're at.

Glenn: Let me take a snapshot of that, the fact that it says ‘audio 15, 17, 25’, randomly, that’s of interest ().

Mark: Yeah, and it’s not good housekeeping, I’d murder my students for it. But whatever, I’m not going to criticise.

Glenn: No, but you’ve still got to contend with it?

Mark: Yeah, I don’t know what’s what, what’s vocals… so I’m going to move them and colour code them into rhythm section, vocals, instruments, and shit… (or) stuff, you know what I mean? So, I know where I’m… so when I get going I want to move fast, I don’t want to be going where’s that?... I think that’s the process now.

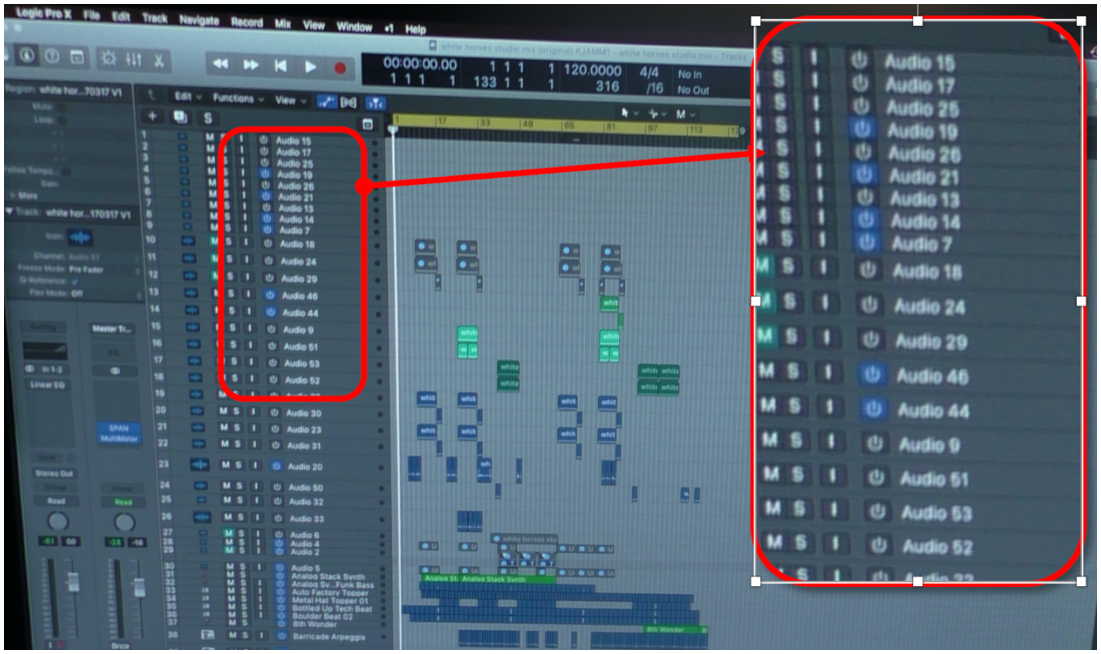


Figure 62 – Screen capture of the composition of musical data handed over to the producer.

What this extract demonstrates is that not all stages of the process are accomplished with an organisational perspective that accounts for future processes. Metadata work, such as labelling and organising the layers of sound, may not be a primary concern for certain parts of the process and here we might speculate that this organisational aspect of the work has been abandoned and deferred in order to make way for the creative process, per the observations in Chapter 6. For planned future stages of the stages of the production process, however, reconstructing the metadata in the form of labelling and organisation of sound is crucial as these activities require the reuse of the song data.

7.3.2 A) Housekeeping

In the absence of any handover notes, the song data often requires a degree of deconstruction in order to make sense of the layers of sound making up the musical composition, which is turn also accountable to the production work hitherto completed. Unpicking the song data is a methodical process in which audio tracks are auditioned one at a time in the DAW in order to ascertain the musical part assigned to the track. The subsequent methods for their reorganisation includes:

- *Re-ordering* – in which the display order of track is altered, typically to group sound by their musical parts. For example, multiple layers of backing vocal harmonies;
- *Labelling* – digital text applied in the DAW to indicate the musical content assigned to each track. For example, 'kick drum', 'hi-hats', 'vocals', 'bass', etc…
- *Colour coding* – may be added to tracks and their audio content in the DAW, to enhance the navigability;

Layers of sound may also be aggregated to fewer tracks, where musical parts are spread over multiple tracks, in order to simplify the arrangement and therefore any future processes that reuse the song data.

7.3.3 B) Uses of Metadata in Housekeeping

Restoring order to the song data involves deconstructing, reorganising and reworking the handed-over song data in preparation for the next stages of the process. In this study, this is an ad hoc activity is a significant overhead of work for the producer because, as we have explored in the previous section, the result of the artist's process seemingly overlooks the organisation of musical data for hand-over to future processes. The following extracts demonstrate the practical actions involved in demonstrating these concerns.

Re-ordering and Labelling Audio Data

To do this the producer methodically sets up playback loops; solos, listens and reorders and renames tracks; filters unused/inactive tracks and moves to the bottom of the arrangement window.

Extract 23 -Making Sense of the Compositional Elements, Filtering and Reorganising Sound.

Mark: I'm just going to get on with figuring out what the hell's going on here and moving things around [starts playback]

Mark: [Solos track labelled 'Bottled Up Tech Beat', only drums can be heard; clicks and drags track to top of the list];[Solos track labelled 'auto factory topper', clap sound is introduced; clicks and drags track to second from top of list];[Solos track labelled 'Metal Hat Topper 01', metallic rhythm sound is introduced; clicks and drags to third from top of list];[Renames 'metal Hat Topper 01' to 'clap'];[Renames 'auto factory topper' to 'shak'

(shaker)]; [Solos track labelled 'Boulder Beat 02', additional drums can be heard; clicks and drags track to second from top of list ('clap' and 'shak' tracks move down one place in the list)]; [Solos track labelled 'Analog Synth Funk Bass', bass part is introduced; clicks and drags track to fifth from top of list.]

To filter, reorganise and label all of the tracks takes the producer around 50 minutes in total, starting with the rhythm and drum instruments, bass, vocals, then all other instrumentation. All tracks are named with the labelling assigned by the DAW at the time of creation, although not all tracks require renaming as the default labels are sometime sufficiently descriptive (for example Analog Synth Funk Bass). Default labelling is problematic, however, when organising the vocal parts as there are tens of tracks containing layered harmonies each named 'Audio x' (where 'x' is a track number). The producer uses the same methods of filtering, reorganising and relabelling to classify the vocal layers, for example lead vocal, ad libs, low and high harmonies, to consolidate the audio to fewer tracks and gain an understanding of the composition and to enable the mixing stage to proceed efficiently.

Colour Coding

To bring about further organisation, the producer colour codes tracks in order to distinguish them as belonging to a group based on musical elements (bass, drums, vocals etc…). The producer's choice of colours is personalised to account for his colour blindness and must use a scheme that uses sufficiently high contrasting colours in order to distinguish the groups.

Extract 24 -Colour Coding

Mark: [Drags cursor around all clips on tracks 1-5 to highlight (drum and bass tracks); uses keyboard shortcut to open color options, chooses brown to colour all parts.
Mark: [Drags cursor around all clips on tracks 6-10 to highlight (synth tracks); uses keyboard shortcut to open color options, chooses yellow to colour all parts.
Mark: Drags cursor around all clips on tracks 6-10 to highlight (synth tracks); uses keyboard shortcut to open color options, chooses yellow to colour all parts.
Glenn: Do you have any particular preference for colour coding?
Mark: Something I can distinguish, I'm colour blind.
Glenn: Ah, right!
Mark: [Drags cursor around all clips on the tracks 11-17 to highlight (male vocal tracks tracks)]
Mark: Something that's contrasting enough for me to er… I tend to go for blues for vocals or bluey type of colours…
Mark: [uses keyboard shortcut to open color options, chooses dark blue to colour highlighted parts.]
Mark: …And browny earthy things for rhythm sections.
Mark: [Drags cursor around all clips on the tracks 18-34 to highlight (female vocal tracks)]
Glenn: OK
Mark: But that's in my head, god knows what they actually turn out like especially if screen (inaudible) I'm terrible.
Mark: [clicks timeline to undo highlight; Drags cursor around all clips on the tracks 18-27 to highlight (female vocal tracks)]
Mark: So, I'm going to distinguish female vocals and backing vocals from (vocal) effects really [drags cursor to extend highlighting to track 28] that's an adlib (inaudible) [chooses indigo from colour options to colour highlighted parts]

Mark: [Drags cursor around all clips on the tracks 11-17 to highlight (male vocal tracks tracks); chooses light blue from colour options to colour highlighted parts (changes from dark blue for contrast with neighbouring indigo parts)]
Mark: And then… …these are all (vocal effects) [Drags cursor around all clips on the tracks 29-40 to highlight (vocal effects); chooses red from colour options to colour highlighted parts]
Mark: [Drags cursor around all clips on the tracks 40-50 to highlight (inactive tracks); chooses green from colour options to colour highlighted parts]
Mark: [Drags cursor around all clips on the tracks 51-55 to highlight (inactive tracks); chooses purple from colour options to colour highlighted parts]
Mark: [Closes colour options] right so… we've got some organisation (Figure 63).

Further organisation is brought about using colour coding of tracks, in order to distinguish sounds as belonging to a group that makes up a musical part. Along with the labelling, this enables the producer to be able to work quickly to navigate and mix the tens of layers of sound in the composition.

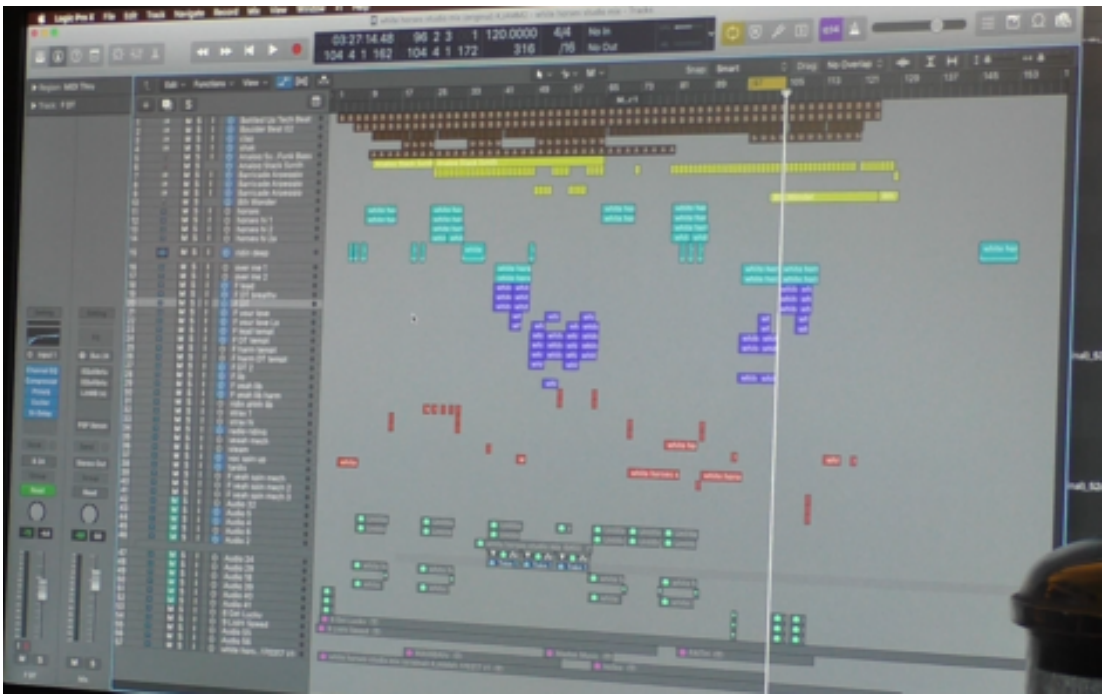


Figure 63 - "We've got some organisation" The reorganised, labelled and colour coded composition.

7.4 SUMMARY OF A STUDY OF PROJECT STUDIO PRODUCTION

The study observes a professional producer doing a mix-down of a local artist's demo songs as part of a hand-over stage of a collaborative music project. The analysis primarily reveals significant metadata problems between collaborative music production activities done remotely, specifically in the hand-over of musical data assembled in the DAW to make a song. Although the artist and producer use compatible DAW software, which affords relative ease in the handover of musical data, tensions still occur between these activities as the organisation of sound in the creative process (the composition) seemingly overlooks the requirements of later processes (the mix-down).

About the Metadata

The handover process results in a significant overhead of metadata work for the producer to un-pick the artist's work and create new metadata to reorganise the composition in preparation for mixing and other future production processes. This includes filtering, reorganising, and labelling sounds; colour coding and ordering tracks; filtering other potentially problematic musical data; using graphical representations of sound to evaluate sound.

Other unique observations concern *potential* uses of metadata to support the broader process and add value to the finished products. Respectively, these include capturing the assignation of writing credits to whole or parts of a song for intellectual property rights management; and capturing aspects of the artistic brief, particularly references to other music, for potential consumer interest.

Chapter 8
Discussion

In this chapter, we discuss what has been learnt from the findings and how this contributes to understandings of modern music production, the role of metadata, and to design. *Firstly,* the discussion begins with an examination of standard music production models in comparison to the findings to demonstrate that such representations do not lend themselves to modern music production. *Secondly,* understandings of the creation and use of music production metadata in a social context are discussed that highlight its role in annotation practices and coordination. *Thirdly,* the social character of music production metadata is discussed and implications and opportunities this has for the design of music technologies. *Finally,* the discussion concludes with a discussion of the limitations of the work and opportunities for future work.

8.1 THE DISSOLUTION OF STANDARD MUSIC PRODUCTION MODELS

Understandings of music production have largely developed around the commercial recording studio, the traditional centre of production, through the documentation of standard models of practice. These models detail workflows, process descriptions, role description and formal recording techniques that aim to standardise the production process. This practice has developed out of necessity; commercial recording studios are a highly controlled environments built around state-of-the-art recording equipment and operated by skilled practitioners, all of which makes studio-based production a costly enterprise in which the highest standards of professional practice are held to account. However, in the "post-mp3-crisis" world the practice of standard process modelling still persists, despite the radical diversification of music-making practices that now extend beyond the declining recording studio sector.

Examples of models in the literature are examined later in this section and include firstly, the "traditional" model; and secondly, a speculative attempt to standardise modern practices. These are compared and contrasted with retrospectively generated 'models' derived from the studies to demonstrate that modern music production processes are extremely difficult to hold to a 'standard'. From this observation it is proposed that better understandings of music production might be gleaned through inquiries into the ad hoc assemblages of locally adequate practices, per the approach taken to this research, that are otherwise overlooked in the literature.

8.1.1 The 'Missing What' in Music Production Literature

In audio engineering literature, documentary accounts of music production tend to draw upon the author's own experiences of working in the industry [29,111,163,229] and/or anecdotes and interviews with audio engineers and music producers [172,219]. These kinds or reportage often describe the process of making recorded music as a set of philosophical approaches and theoretical abstractions, as well as employing representations such as process modelling, which we introduced above and will revisit later in this section. However, as discussed in chapter 3, the actual real-world, real-time character of just *how* work practices are accomplished is distinctly absent, which in turn is of limited help in our concern with design. This is a symptom of the 'Howard Becker phenomenon' as coined in Harold Garfinkel's critique of the missed orderliness of everyday accounts in sociological inquiry, which coincidentally refer to Becker's studies of jazz musicians.

> "…To take Becker's studies for example, we learn that there are jazz musicians, where they work, who they work with, what they earn, how they get their jobs, or what the audience will request of them. But nowhere in the articles can it be read, and no interrogation of the articles will supply that in just those places, just those persons, with just who is there, and at just that time, with the materials and under the circumstances at hand must in and as their local work make music together" [89]

This may seem an unfair comparison considering these texts do not purport to present the kinds of sociological inquiry that Garfinkel seeks to criticise and respecify through EM analysis, however his critique holds even for members' accounts of their own work in "occupational practices of every sort" [89].

The critique that there is a 'missing what' from professional accounts of music production is also especially salient, as there is much emphasis in music production literature on social coordination being the cornerstone of success. We are told that successful music producers require the core attribute of being a 'people person', skilled in facilitating smooth social interactions and balancing the subjectivity of the artistry, against the objectivity of technical and business requirements [29:7]. For example, a producer might be required to exercise subjectivity to attend to an artist's sensibilities surrounding their musical creations when developing a song; create an ideal ambience in the recording space to elicit a good performance; or balance a group's dynamics to ensure fair contribution. In contrast a producer is also required to objectively attend to the practicalities of project management coordinating budget, personnel, equipment and studio space, and to meet the business goals of the record label. However, just how members accomplish all of these, and a whole spectrum of other constituent production activities, through locally accountable practices are notably absent in these writings.

Models as Representations of Practice and the Issue for Design

The documented understandings of music production then are problematic as a resource for design as they miss member's methods for making their actions observable and reportable to sufficiently inform designers just what a system is supposed to do. What is available for design then is at best in the kinds of scenic descriptions, interviews and anecdotes that that consistently miss the naturally accountable and observable features of that work; and at worst in representations such as process charts, models, and theoretical frameworks that "black box" the work altogether, depicting the work at the 'level of transaction'.

Lucy Suchman [202] cautions design ethnographers to undertake a 'reflexive engagement' in examining work through the kinds of interpretation and understanding that members produce and raises several 'issues of representation' for design. For example, it can be beneficial for members to obscure work from external perspectives, in order to shape their own practice; control how their work is represented, valued and utilised; and to circumvent a host of issues that might surface from exposing work practices. This latter point is salient to this research, as some potential participants in this research perceived a threat to their livelihood from displaying their skills (see Chapter 4). Issues also arise from 'idealised' accounts that "black box" the work of others, such as process models. As a resource for members to reason about their own work these representations are not necessarily problematic, however when produced at distance from the work are increasingly disparate from its real-world practices, endogenous order, and contingencies.

According to Suchman then, standard models as a representation of work, when used cautiously as part of the work landscape of a study site, can contribute to the mix of resources available to inform system design that includes 'ethnographic' field work. However, as we will see later the studies have not only opened up the "black box" on modern music production practice but have also demonstrated that modern music production no longer adheres to a standard process models. In order to ascertain why models of music production have outlived their usefulness, as confirmed in the findings, this section discusses how the processes, environments, and roles of actors involved have steadily been shaped through controlled technological change, in comparison to the rapid and far reaching change brought by digital technology.

8.1.2 The Influence of Technological Change on Music Production Models

In this section we briefly discuss some of the key technological developments that have impacted the music production process, from the inception of recorded sound in the late 19th Century through to contemporary digital technology. From this we can see that technological developments affecting processual change is not new in the domain of music production, however digital technology is unique in the scope and pace of its transformative influence toward widening the accessibility to music creation tools and a diversity of music-making methods.



Figure 64 - A Typical Recording Session at Victor – taken from [18]

A Brief History of Recorded Sound

Earliest musical recordings involved arranging musicians around the recording horn of the mechanical recording equipment (Figure 64). Recording time was restricted to four minutes per side of wax disk and musical arrangers had a role in re-scoring long classical pieces with regular breaks for small ensembles of only instruments loud enough to translate well to recording (for example the double bass would be substituted for a tuba). Engineers acoustically balanced sounds, varying the proximity of instruments to the horn and even moved singers on a trolley to even out the loudness between passages of music [18].

From the 1920's the uptake of the microphone and electro-mechanical recording technology eased the restrictions of acoustic recordings, enabling a wider range of instruments to be recorded and in more conventional performance scenarios [84].

From the 1940's Magnetic tape enabled longer recording times and even higher quality of recording and by the 1950's multi-track recording machines became available that could record audio information to four, then later eight, discrete 'tracks'. This allowed engineers to separate and layer sound, which gave way to a new process of transferring a mix of recorded sound either to one track to free up tracks and increase the musical options, or to a final mono or stereo master copy. From the 1960's music production centred on the affordances of multi-track tape which increased in capacity to 16 then 24 tracks [219:1]. Recording consoles and the studio spaces themselves were developed with sophisticated facilities to process multiple channels of audio and to separate sounds not only from each other but from the environment itself in acoustically 'deadened' and isolated rooms. This yielded further possibilities in the mixing process as engineers could now give sounds given a different sense of space and balance using effects. In the 1970's, studio capacities reached up to 96 channels of audio and recording consoles became more sophisticated with integrated computers to capture, recall and automate control settings in real-time, allowing some production activities to be set aside and picked up at a later date with no loss of 'meta' information such as the balance of audio levels [219]. In the 1980's, MIDI (Musical Instrument Digital Interface) control protocol was developed for hardware or software note sequencers, electronic synthesisers, drum machines, and samplers, enabling the music itself to be automated. Technology was now a generative component of the creative process that combined human and machine performance and marked the beginning of affordable consumer music production in the home. This posed no business threat against the quality of professional studios, however the industry was soon set to lose control of the entire music value chain in the 1990's mp3 crisis and the advent of even more powerful and accessible digital audio tools.

The Advent of the DAW and the Respecification of the 'Studio'

Digital audio emerged in the 1980's via the CD, and multi-track DAT (digital audio tape), then in the 1990's the DAW emerged with the capability to record digitised multi-track audio to a computer hard disk. The DAW was more than a substitute for recording to tape, as software provided integrated MIDI programming and control; powerful audio editing tools; and tools for mixing multi-track audio. As computer technology improved, powerful audio effects, processes, and even synthesised and sampled instrumentation virtualised entire processes and eliminated degradations in quality in the transfer between digital and analogue audio domains. This development alone had a monumental impact on music production, drastically reducing the hardware needed to make music and marking the beginnings of professional quality 'in the box' production requiring only few pieces of affordable equipment. Expensive recording studios were no longer necessary in music production and any number of practical locations, bedrooms, basements and garages, could become a 'studio' equipped with a modest amount of musical equipment and a DAW.

The Transformation of the Music Production Landscape

The development of DAW software and digital distribution of music has drastically changed the music industry over the last two decades, which has been notoriously slow to adapt and create opportunities from these changes. However, as the potted history above demonstrates this has not always been the case, as over a century of technological innovations have consistently benefited the music industry and progressively shaped its production methods and processes. In contrast, digital technology has brought about a much larger and radical transformation that is unique in its complexity and scope compared to any other point in the history of recorded music. As successful music producer and impresario Richard Burgess states:

> "Our industry, born of Edison's technology, was threatened by radio, a depression, strikes, materials shortages, and recessions. Corporate consolodations negatively affect creators, and independent expansion introduces new musical movements. However, no change was as disruptive as the evolution of the digital supply chain, which was transformative from conception to consumer" [29:239]

While some aspects of the music industry have diminished, including the recording studio sector, new opportunities have emerged such as artist self-production and publishing which have created an unprecedented diversity in the ways that music-making is accomplished, enriching and making music participation and consumption more accessible than ever.

Understanding Production in the Post-mp3-crisis World

This diversity, however, adds to the ongoing problems surrounding the study, understanding, and representation of modern music production as music-making moves away from the traditional production centre of the recording studio; a highly controlled environment with well documented practices and procedures for making records. Beyond the recording studio, the geographic and chronological distribution of production processes, often facilitated through technological networks, present further challenges in accessing and studying modern production processes [219:6]. Currently then, there is a dearth of empirical understanding surrounding an apparent wealth of modern music production scenarios, meanwhile standards model of commercial recording studio music production still prevails throughout the literature. In the next section we explore two existing standard models and compare and contrast these to retrospective models derived from the studies, to demonstrate a heterogeneity to music making approaches that cannot sufficiently be represented in a processual standard.

8.1.3 Existing Models of Music Production

The "Traditional" or Standard Production Model

Prior to the transformative effect of the DAW, music production process was scaffolded by a standard guiding model, which although was not without scope for experimentation and innovation in recording practices, was centred on the controlled environment of the recording studio. What has since become known as the "traditional" model theorises the process as a series of discrete stages, represented in Figure 65, in which artists would work in coordination with a team of professionals with specific roles to progress musical ideas toward realisation as piece of recorded music [111].

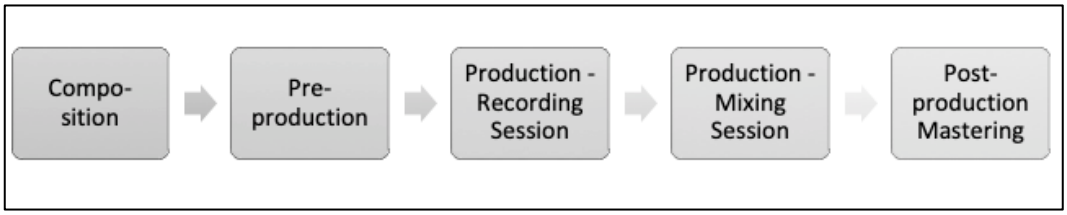


Figure 65 - The Traditional Production Model adapted from Hepworth-Sawyer and Golding [111]

In this representation, the music-making activities themselves are 'black boxed' and obscured from view and are only understood in terms of process descriptions; the actors involved and their role descriptions; and transactions of inputs and outputs. The following is summary of each of these factors, as they contribute to the understanding of the traditional production process.

Actors and Roles

In terms of the key actors involved, the process largely centres on the artists, or the performing musicians and singers that own some or all of the credit for the music, artistic concept, brand or name. The *producer* is the next key actor whose primary role is to oversee and coordinate all aspects of the production process toward developing a musical product with the artist and all other actors in both artistic and technical roles. Sponsoring the production traditionally falls to a record company, which has various internal roles not elaborated on here, but who as a stakeholder may provide input on the creative direction of the production at various stages to secure commercial success.

Artists and producers may also take on other artistic roles including *songwriter* for the creation of original of song material, but this can also be an independent role alongside composers and lyric writers, as some solo artists and bands may not write their own music. Songwriters/composers, and producers collaborate closely with or take on the role of *arranger,* specialising in adapting, refining and preparing scored music for performance. These musical arrangements may require *session musicians* who are hired to perform on a free-lance basis during a recording session and who often

contribute musical ideas although they are often given little or no stake in the artistic credit.

The key technical role in production is the *engineer* responsible for operating audio equipment and applying critical listening to shape recorded sound such that is it is sympathetic to the music. Engineers are usually free-lancers who specialise in different stages of the production and whose roles are named according i.e.: *recording engineer, tape operator, mix engineer, mastering engineer*. *Assistant engineers* are also usually employed directly by the studio to assist engineers in operating the recording equipment but can also be hired directly by engineers themselves. Finally, *studio managers* are responsible for coordinating recording studio operations and assistant personnel with roles and responsibilities that include maintaining equipment, assisting engineers, and catering.

The Process

The *composition* stage aims to develop song ideas as close to completion as possible before taking them through to production stage. Artists, songwriters, and producers variously collaborate to create musical ideas as individual songs or a collection of songs in written form (notations, music scores, and lyrics) or as basic audio recordings.

Following the composition stage, producers, artists, songwriters/arrangers, and the record company undertake a *pre-production* process to prepare for the production stage and optimise expensive studio time. This involves stakeholder meetings to discuss musical directions, business aims, and selecting music to be recorded; rehearsal and refinement of musical arrangement; creating basic demo recordings; booking studios, equipment, engineers, and session musicians. The outcomes of this process are for music to be prepared in written or audio recorded form; artists and other musicians to be well-rehearsed and prepared; and a guiding project plan or brief for the production stage.

In the *recording session stage* of the production artists, producers, session musicians, recording engineers and assistants, and the studio managers coordinate their roles to execute the pre-production plan and capture real-time performances of songs. The exact process will differ depending on the musical content and may even involve deviations from the plan and even unplanned contingent activities. Regardless, the process results in multi-track song recording that are passed over to the *mixing session stage* in which a mix engineer, with artistic direction from the artist, producer and record company, applies critical listening, and audio processing and effects to balance and transfer the multi-track audio to a stereo/surround sound audio ‘mix-down’.

Finally, in the *post-production mastering* stage a mastering engineer takes the audio mix-down and applies critical listening, and audio processing to optimise volume, correct errors and glitches, and re-balance any musical features in the mix-down, before transferring to a finalised master.

The summary above is, of course, not exhaustive in its detail but gives a good overview of the process according to the available literature. Some variations to the model are noted from project to project with musical genre in particular introducing unique features to the process. For example, improvisational music forms, such as jazz, may bypass all activities surrounding the firming up of musical writings and arrangements. Also note that the traditional model is distinctly centred on capturing real-time human music performances, which is a feature that is almost absent in some electronic music genres that involve automation and programmed sounds. This genre specificity, largely driven by technologies including the DAW, have been a major factor in reshaping music-making activities away from the traditional model and beyond the recording studio toward a transformation of music production processes and roles.

The Post-mp3-crisis Production Model

Modern music production practices are widely acknowledged in the literature, however there are few, if any, representations that might be considered as detailed and established as the traditional model above. Modern music production may not involve the recording studio exclusively, if at all, and are often part of a hybrid process that coordinates outside activities to incorporate real-time musical performances with programmed or pre-recorded sounds. As a result, recording studios now operate on much smaller scales and those involved undertake roles transformed from traditional definitions [219].

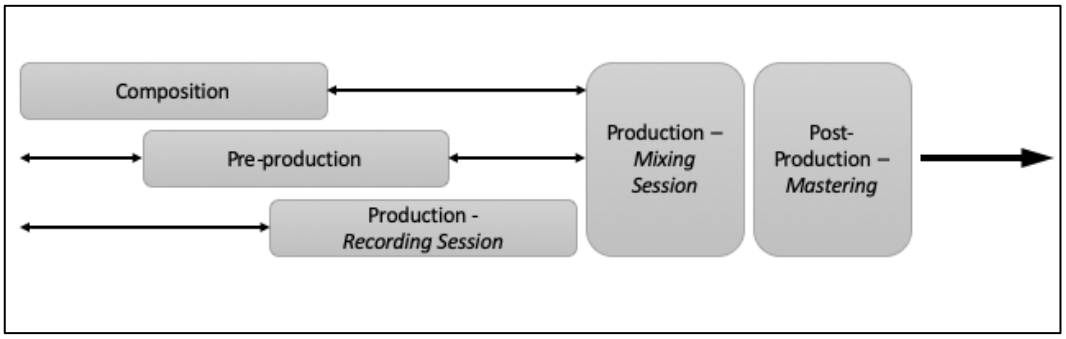


Figure 66 - A Potential Modern Production Process - Reproduced from Hepworth-Sawyer [111]

The changing role of the studio and music producers, and the recognition that DAW technology is adaptable to a broad range of musical activities provides the basis for the speculative model depicted in Figure 66, which shows a free flow of work between overlapping stages of the production process. Again, this model 'black boxes' the work, leaving much of what is understood about the represented flows of work to speculation which in turn leaves several questions open: What parts of the work overlap? What objects if any are exchanged between stages? Where does each stage of activities take place and who is involved? There is, however, a more fundamental

issue with this model in that it distorts the existing traditional model and draws upon its discrete stages as placeholders for activities that are not fully understood. The model attempts to classify activities, rightly or wrongly, according to existing understandings, however this approach brings us no closer to explicating the everyday orderliness of modern music making methods.

Actors and Roles

Much of the understanding surrounding modern music practices in the literature turns upon the documented changes to traditional production roles and emerging definitions of what it means to 'produce' music beyond the recording studio. For example, the traditional role of producer was to coordinate all aspects of the production process including the artistry, the technical team, and the business aims, the end result being an artistic 'production', much like in the sense of film or theatre. However, the ubiquity of the DAW has changed the meaning of what a 'producer' is significantly to include individuals that make recorded music 'products' in all manner of different ways [111].

In order to apprehend the changing roles and methods of music producers, Burgess [29:9–19] defines six producer typologies that attempt to cover the full gamut of modern music production scenarios and describe roles that range from complete control over all aspects of making music to hands-off consultation (Table 9). In contrast, however Hepworth-Sawyer and Golding [111] define two music producer typologies that have amalgamated with other roles: the *'musician producer'* who approaches music production from the compositional and creative perspective to develop music, often using available production tools; and the *'engineer producer'* who combines the traditional roles of engineer and producer, both taking responsibility for artistic direction and the capture of musical performance.

Table 9 - A Summary of Music Producer Typologies according to Burgess [29]

Producer Typology	Description
Artist	Music artists who record and produce their own music. A growing class of producer enabled by digital audio technologies.
Auter	A producer that audibly brands their music with a unique sonic identity or "their sound". Usually in collaboration with non-writing artists.
Facilitative	Takes on a supportive role to facilitate the realisation of the artists ideas.
Collaborative	Limits their control over the production to bring "extra-band-member-mentality" to the process.
Enablative	A more traditional role akin to a broader music business role of Artist and Repertoire involved in scouting and developing talent prior to recording.
Consultative	A less hands-on role, the consultative producer provides mentorship and "fresh ears" to steer the artistic direction of the project.

8.1.4 A Critical Comparison of Standard Models to the Findings

The examples above neatly demonstrate the issue with using process models for representing working processes in music production, whether based on established understandings, as in the traditional model, or tentative understandings, as in the modern production model. The definitions and terminology applied to stages of the production process, and the role descriptions of the actors involved, act as categorisations for any number of activities that include similarities amongst its features. This is one device through which models give the appearance of being a good fit, or accurately describing a process, however in reality the categorisation of activities is an indicator of what Wittgenstein termed as "family resemblance" in the way phenomena are described and organised in language. [18].

> "...Consider for example the proceedings that we call "games". I mean board-games, card-games, ball-games, Olympic games, and so on. What is common to them all?—Don't say: "There must be something common, or they would not be called 'games' "—but look and see whether there is anything common to all.—For if you look at them you will not see something that is common to all, but similarities, relationships, and a whole series of them at that. To repeat: don't think, but look!—Look for example at board-games, with their multifarious relationships. Now pass to card-games; here you find many correspondences with the first group, but many common features drop out, and others appear…. … I can think of no better expression to characterize these similarities than "family resemblances"; for the various resemblances between members of a family: build, features, colour of eyes, gait, temperament, etc. etc. overlap and criss-cross in the same way...."

This "overlapping and criss-crossing" of resemblances is hugely evident in the studies, for example, substituting a song to be recorded during a studio session (see Chapter 5) introduces a feature of pre-production planning to what is otherwise nominated as the recording production phase. Similarly doing a mix of the recordings (see recording studio study, rough mix section) introduces a feature of the mixing production phase, according to the traditional model above. The examples above are taken from the recording studio study in which the members attempted to follow the traditional process. However, they demonstrate that even this well-established model fails to account for occasioned contingent activities or explain, for example, what might be the reason for any tangential activity being initiated or a process being repeated; or what actions to take when something goes wrong or if there is a change of plan.

When comparing the activities of the home studio, and project studio studies to the models above, family resemblances are markedly more pronounced. Some of the activities observed in these studies bear resemblances that variously span and cross-over the boundaries of each stage of the process, as set out and defined in the models. The potential model of modern production (Figure 66) apparently accounts for this, representing a fluid process in which activities apparently slide seamlessly between each distinct orientation of work. A clear sequencing of the work is largely abandoned for a loosely formulated ordering of the processual stages, but the reasons for changes in the direction of the process cannot be found in the model's descriptions and

definitions. This is hugely problematic as process modelling turns upon the sequencing and ordering of discrete and defined stages of work; serial processes with clear pre-requisites to each stage are not too difficult to devise into a model resembling the flow of work. This is possibly why the "traditional" standard has endured: despite its inadequacy to capture all possible production scenarios it centres on highly controlled procedures enacted in the recording studio. However, beyond the recording studio the heterogeneity of modern production processes is far more pronounced, such that the limits of what can possibly be encapsulated in a generic process model has been significantly exceeded. In order to demonstrate this, the following is an analysis of all three studies that presents the findings in the form of three distinct models constructed retrospectively.

Modelling the Study of Recording Studio Production

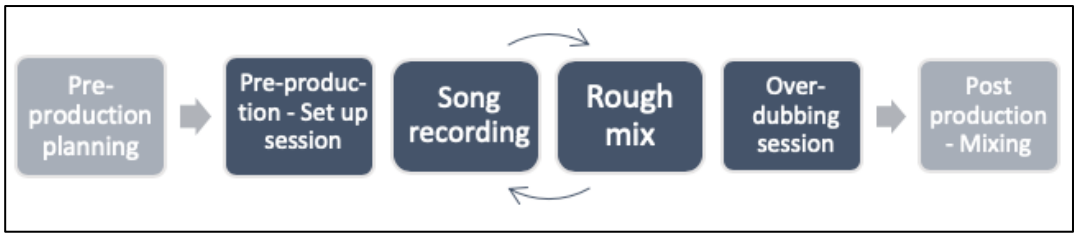


Figure 67 - A production model derived from the recording studio study.

Figure 67 is a model derived from the study of recording studio production (reported more fully in chapter 5), which centres on a semi-professional cover version band recording several songs from their repertoire to publish as promotional material on their website. Samples of their performances were aimed toward giving prospective music promoters a good idea of what the band sound like in live performance and the type of music they can expect to hear if they were to book the band to play at their venue. The recording session took place over three days in a traditional recording studio setting in which a process of work played out between the actors, the five band members and the recording engineer, to collaboratively produce several recordings of real-time music performances. The following defines and describes the observed course of action in the manner of a process model, as it might be derived to represent similar small-scale recording studio projects.

Actors and Roles

As *musicians*, the five band members performance roles were singer, lead guitarist, rhythm guitarist, bass player/backing singer, drummer, respectively. The role of *producer* was shared between the singer and rhythm guitarist as *musician producers*, taking the lead on artistic decisions and directing musical performances; and the recording engineer as *engineer producer* responsible for operating the recording equipment, but also contributing to directing the musical performance and production decisions.

The Process

The *pre-production planning* stage was not observed and is described speculatively here. The musician producers coordinated with the musician to rehearse the music and make song selections and coordinated with the engineer producer to schedule and plan the studio sessions in order to optimize productivity in the studio time available. The output of the preproduction stage a set list of songs that the band wanted to record and an outline plan for activities in the three-day recording session.

In the *pre-production – set up* stage, the musician producers and the engineer producers collaborate to configure and test the recording equipment to provide for the *song recording* stage in which the musicians perform songs together in real time and each musical element is captured in as much acoustic isolation as possible. The multi-track recordings are later blended and treated in the DAW in a separate mixing process, but during the recording stage the engineer producer undertakes a peripheral *rough mix* stage in order to provide a representation of the final product as a mid-process quality check.

In the *overdubbing session*, the engineer producer reconfigures the recording equipment and the multi-track recordings so that the musicians can layer additional instrumentation and vocal performances over the song recordings. This stage finalizes the production and the engineer producer transfers all of the recorded songs to a *post-production – mixing* stage. Again, this stage was not observed and is described speculatively. The engineer producer balances and treats the multi-track recordings before transferring them to a stereo mix-down which is then sent to the musician producers for feedback. After receiving feedback, the engineer producer makes adjustments and produces a second mix which he then hands over to the band [17].

Critical Comparison to Standard Models

The model above has many resemblances with the traditional model, for example the coordination done in pre-production outputted a selection of songs and plan of action for the production. The production itself is centred on recording techniques for capturing real-time performances, as well as augmenting the recordings with overdubbing activities. There are several significant key differences, however. Firstly, the combined roles of engineer producer and musician producer are established, as partly defined in the potential model of modern music production (above), as opposed to the traditionally demarcated roles of musicians, producers, and engineers. Other traditional roles are also absent, such as songwriters, or arrangers, however this can

[17] This information was garnered from the engineer producer in a post-study debrief. The band eventually decided not to use the recordings as they were seemingly not satisfied with the end product.

speculatively be attributed to the song performances being covers of original songs, meaning the production aims were re-creative rather than creative. Accordingly, the composition stage is absent, which alongside the other reformed production stages provides a departure from the traditional model.

Opening the "black box" revealed a significant amount of contingent action in the process that suggests there is greater amount of ad-hoc practice that models suggest. For example, decisions made in pre-production are not immutable and in the study a change was made to set list of songs in the recording phase and therefore the altering the intended outcome of the project. The rough mix is depicted here as a peripheral planned activity, but in reality, was a production stage brought forward as a measure of 'social smoothing', in order to satisfy musicians that the recordings were up to their expectation, which otherwise threatened to derail the process. Finally overdubbing constituted a 'process within a process', in which the recording configuration was modified contingent to the anticipated ad hoc decision making about the only partially planned overdubbing activities.

Modelling the Study of Home Studio Production

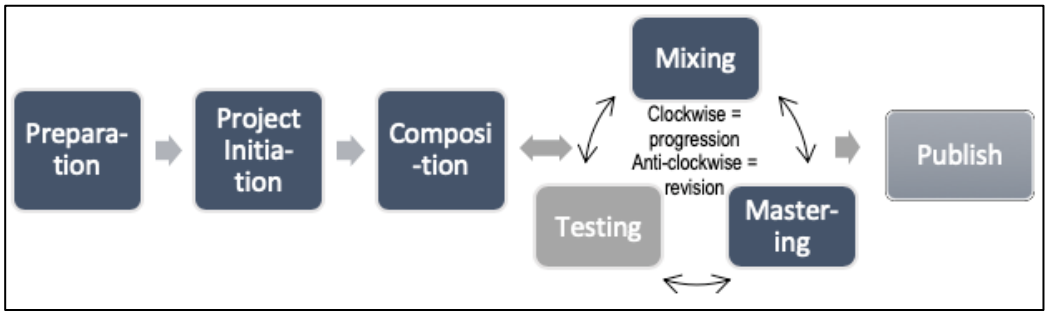


Figure 68 - A production model derived from the home studio study.

Figure 68 depicts a process model derived from the study of home studio production which centres on an electronic dance music producer working alone in a spare room of his home to create songs in a complete end-to-end process performed exclusively in the virtual environment of the DAW. Music is created for impact when played back on club sound systems (i.e. loud, energetic, and with a prominent bass sound) providing an example of recipient design at work.

Actors and Roles

The *artist producer* (see producer typologies in Table 9) creates music for his *independent music company* that largely earns its revenue through live DJ performances in night clubs. The originality of the music is key to ensuring that the producer and *DJs* on the label can compete for lucrative bookings by maintaining an exclusive musical repertoire that is up to date with the latest musical trends in the Drum 'n' Bass genre. Other collaborators include independent *artists* such as singers and other producers with whom the producer may have occasion to create music with.

The Process

In the *preparation* stage of the process the producer sources and creates digital sound files and organises them into a sound library. This is done as a stand-alone process to create and maintain a crucial resource in the composition stage for future productions. In *project initiation* the producer considers any rationale for a musical project, for example creating original material for and upcoming tour; reworking/remixing existing songs; or contributing to a collaboration with other producers/artists. The producer gathers resources that include reference material or songs with musical features fitting the project aims; and sounds to form the basis of the composition, including tracks from previous compositions. The computer file system is used to gather the resources which are then gradually transferred to the DAW as it is set up and prepared for the *composition stage* with pre-treated and mixed groups of sound elements.

Creating the Tune involves searching for, creating, auditioning, and assembling and blending sound clips into a composition of musical parts (drums, bass, effects etc.) and layers of sound. The DAW is used to loop playback of several bars as the producer imports, layers, and temporally places sounds to develop musical ideas, section by section until the song is completed. This process also involves treating and developing sounds along the way to develop a rough mix. Several compositions may be completed before a more refined process of *testing, mixing,* and *mastering* is undertaken. This process is an iterative cycle in which rough mixes of songs are initially *tested* on a variety of sound systems such as a car stereo, or studio speakers. Critical listening at this stage informs whether to regress the process to the composition stage for further revision and development, or to progress to the *mixing* stage, in which the producer variously prepares sound layers, or 'stems'; and applies critical listening, audio analysis, audio processing, and effects to balance the mix drawing on reference material to aid the process; then transfers the multi-track audio to a stereo 'mix-down'. The *mastering* stage comes next and again analysis tools, reference material, critical listening, and treatments are applied to the mix-down.

The cycle continues on as mastered mixes are tested on a variety of sound systems, but additionally may also be included as part of a DJ performance to test songs on a club sound system and for audience reaction. At any point in the testing, mixing, and mastering cycle the process may regress to the previous stage or composition stage in order to make revisions and alterations. The final *publishing* stage of the process was not observed in the study; however, the study reveals that the producer's record company self-publishes to the BeatPort website which is a publishing portal for electronic dance music.

Critical Comparison to Standard Models

The model above bears some resemblances to the modern model of music production in that it similarly attempts to represent a fluid process in which there is a blurring of what are categorised as composition and production activities. The key differences are that understanding of pre-production differs significantly as being constituted of preparation activities including management of sound sources, either bespoke to the project (original creations or exchanged from collaborators) or as general sound library material. The mixing and mastering activities are also fully integrated into the process, rather than as a discrete stand-alone process, which is not fully conveyed in the representation above. For example, the mix is prospectively configured as part of the initiation work and continuously develops on-the-fly during the composition stage. Even when compositions are complete and the producer dedicates a studio session to mixing several songs, this is in reality undertaking a more advanced stage of a continual process in which nominally "compositional" actions are called upon to develop the song. The testing stage is also novel to music production models and is a hugely significant extension to process that offers a clear example of recipient design at work, as this particular orientation of music-making provides the end product for consumption by DJs and club-goers, rather than more conventional music consumption markets.

Modelling The Study of Project Studio Production

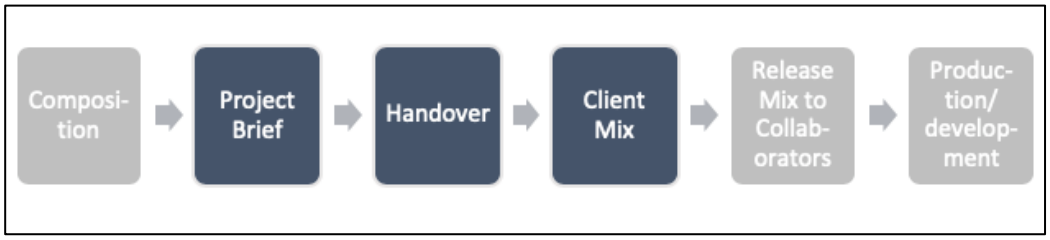


Figure 69 - A production model derived from the project studio study.

Figure 69 depicts a process model derived from the study of project studio production, which centres on an independent producer in receipt of a potential artist client's compositions that are proposed for further development. In the observed studio session, the producer works alone to unpick the artists compositions that have been built in a DAW and reconstitutes them in the form of a 'client mix'. While only a small part of the process was directly observed, the study findings still make a significant contribution elsewhere in this thesis, but even so the description of the wider process that the producer relayed in conversation during the attended studio session is sufficient for the purposes of this exercise.

Actors and Roles

The *artist producer* (see producer typologies in Table 9) independently produces their own music in a process which, although unobserved, produced songs that were assembled in a similar manner to those produced in the home studio. The *facilitative producer* is hired to provide skills to develop the songs toward the artistic goals, which may prospectively include facilitating the collaboration of other collaborative *artists*.

The Process

The artist undertakes the *composition* stage, recording musical elements such as vocals and creating instrument sounds with virtual instruments that are assembled in the DAW to create several songs. In the *project brief* stage, the artist contacts and approaches the producer to collaborate and contribute production skills to the project, this involves a negotiation of services, establishment of roles, and discussions on artistic direction and production possibilities.

With agreements in place and the producer secured to facilitate the production, the process moves on to *handover* of compositions, in which the producer imports the artist's DAW files and goes through a process of critical listening and evaluation. This enables the producer to become familiar with the music, its elements and arrangements; identify areas in which the music might be developed, for example replacing programmed instrumental parts with live musicians; and reorganise the musical elements. This part of the process contributes to preparing for the *client mix*, which is used as a resource to attract potential collaborators, such as session musicians and singers in to the remainder of the *production.* The producer described the production an 'recursive process' in which songs would be developed in iterative cycle of composition, recording (overdubbing), and mixing activities toward a final product.

In this model, like in the home production study, there are resemblances with the modern process model, in that there is a blurring of composition and production activities and again, mix production is integrated into the process. The 'client mix' stage however is done as a discrete process and is done in what might be conventionally recognised as the pre-production phase of the process. There is a key difference here that suggest this is not the case, as songs that are mixed in this stage are the near-fully constituted compositions that the artist handed over, rather than demo recordings that are traditionally discarded as a by-product of the production process.

8.1.5 Summary

In this discussion, we have grounded understandings of music production in a historical context, with a focus on demonstrating that technological changes bringing about processual change is nothing new in the pursuit of making records. The introduction of the DAW, however, proved to bring about a far more radical change, as it enabled music-making to move away from the traditional production centre of the commercial recording studio and into the uncharted territories of home and DIY project studios. Despite this shift and the dearth of academic knowledge in these new areas, standard process models still prevail throughout the literature. These are based on the highly controlled and long-established practices and procedures of the commercial studio that have been moulded and shaped to hypothetically represent music-making practices in the post-mp3-crisis world: an approach which is problematic for understandings in this area and for our concern with design.

The studies demonstrate that the process of music-making is constituted of a continuous flow of ad hoc assemblages of locally adequate practices that progress a piece of music from conception to completion. Standard process models, however, attempt to categorise and sequence these activities according to resemblances with existing definitions and their logical orders of performance. This approach is problematic because, as the studies show, the DAW enables such a broad range of music-making activities that it is no longer necessary to accomplish the process in discrete stages with specific outcomes. In contrast to the findings then, speculative modern production standards attempt to bend and shape existing representations into sequentially fluid and indeterminate flows of work (Figure 66) that only succeed in revealing the conflict between abstract representations and reality.

In order to demonstrate the assertion of this thesis, process models from the studies were retrospectively constituted, using existing terminologies where possible for comparison, in order to reveal significant disparities from standard process models and indeed, from each other. On this basis it is suggested that standard models are no longer suitable for representing modern music production practice and so a different approach is required. What is proposed then is that observational studies can provide uniquely adequate detail about the practical action and reasoning behind music-making activities which are, according to the technomethodological tradition (See Ch.3), better suited to inform design of technology for a wider range of music-making activities. Opening up the “black box” on modern music production reveals some generality in music-making activities across different scenarios, not necessarily in the exact ways in which they are performed, but in work practices and rationale that producers display in organising and coordinating their flow of work. The utility of this approach to observing and understanding music-making is demonstrated in the next section in which member’s work practices are discussed in further detail, in order to address a particular design focus on the creation and use metadata as a resource.

8.2 UNDERSTANDING THE ROLE OF METADATA IN MUSIC PRODUCTION

In this section we discuss the contribution of the findings toward understandings surrounding the creation and use of metadata as a social phenomenon bound up in the work practices of actors involved in music production. In treating the study findings separately from technical topics centred on musical metadata, the discussion focuses on the insights into the social character of metadata in their *in vivo* use: as they are used by people in the real-world real-time pursuit of music-making. These insights show that metadata are multimodal objects that are mostly displayed through annotation practices, or 'metadata work', that coordinate situated activities and prospective provide for future activities. The findings also display 'metadata troubles' in that the utility of metadata, as they are purposed for a specific activity, eventually expires and requires reworking as they propagate through the production process and come up against new orientations of work.

The motivations for taking an analytic perspective on music production metadata are based on a prominence of topics in technology design that centre on the potential for metadata driven applications to exploit new forms of value in the use and reuse of data. Metadata has always been an essential component in the exchange of data in technological systems and has typically been encapsulated in technical standards that purposely limit scope to ensure technical functionality and successful data flow [226]. However, new approaches to metadata, such as ontologies coupled with linked data and semantic web technologies, have enabled greater flexibility and effectiveness in connecting users to data in the digitally networked world [22,25]. These advances have both retained technical functionality while allowing a broader scope of knowledge, artefacts, and events, in real and virtual worlds, to be represented in machine readable vocabularies that can be readily translated and exploited in novel applications for human consumption.

In Chapter 2 we saw that prospects for metadata in the musical domain have been taken up significantly in the field of Human Computer Interaction (HCI) and audio engineering and a survey of the literature uncovered research trends. Prominent in research is the development of audio feature extraction technology, which aims to generate rich musical metadata from audio information, for example note information, tempo, instrumentation, musical structure etc. This technology underpins, in part, the emerging field of music information retrieval that is concerned with exploiting these metadata in novel applications that include: enriching interaction with, for example, musicological archives; improving music recommendation and similarity; and enriching music experiences with novel music players.

Figure 70 shows the quantities of literature and the categories that emerged from the survey, which illustrates a plenitude of technical and theoretical literature on musical metadata and a dearth of real-world studies of human-metadata interactions in the domain of music production. This latter concern is the knowledge gap that this contribution addresses and in the course of the following discussion the study findings are compared and contrasted with existing studies to identify new insights and additions to current knowledge.

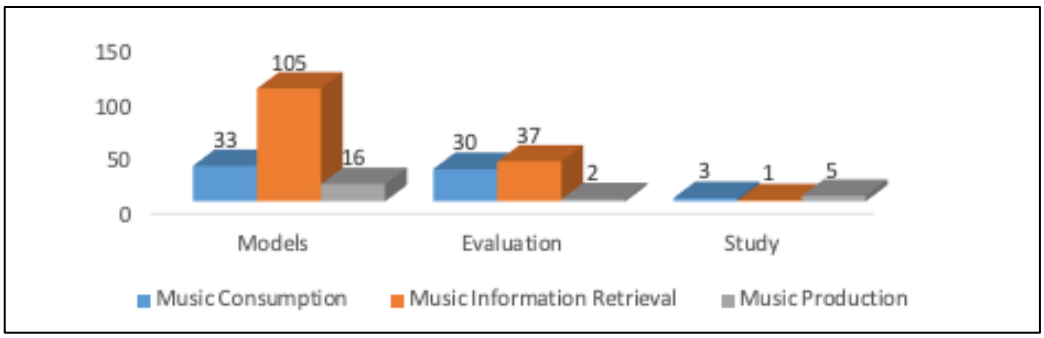


Figure 70 - Numbers of papers surveyed by domain and type

The Knowledge Gap – Understanding Metadata in Music Production

Within academic literature, largely in the field of HCI, there exists a very thin body of studies of real-world annotation practices and human-data interaction, herein referred to as 'metadata work', in music production. This is not necessarily due to the limitations of the survey base however: The Audio Engineering Society library yielded some results but none in this category, and ethnomusicology publications are also included that yielded none. Regarding ethnomusicology, this is perhaps not a surprising find as it is a field that has traditionally shunned the medium of recorded music as an area for study, instead focussing on cultural significances of folk music performance. Suffice to say there are very few ethnomusicological studies of the production of recorded music and none which could be found that provide the kinds of insights, explicitly or otherwise, into metadata or annotation practices in music production.

In the next section of the discussion, we briefly explore the focus of existing texts and the metadata topics that they address. It should be noted that there are other relevant music production studies included in this discussion that sit outside of the literature survey above because they are either not in the digital libraries queried, and/or are not explicitly focussed on musical metadata. A closer inspection of this marginally broader body of findings, however, point toward some further indicative examples of in vivo metadata usage in several music production scenarios, albeit not overtly identified as such. Similarly, engineer's publications give insight into technical expertise and other working practices that involve the production and use of 'metadata' but are not explicitly recognised as such.

8.2.1 Furthering Understandings of the Role of Metadata in Music Production

Documenting the Process

In the traditional model of music production, the prescribed manner completing track sheets and note taking to document the process is distinctly absent in all of the studies for this thesis. The recording studio study, however, provides *new insight* into alternative documentation practices. To document the configuration of recording equipment for example, the engineer annotates the equipment controls with physical labelling written on the recording console and digital text displayed in the software, that contains 'situated' metadata about the set up.

Documented in these annotations are shorthand descriptions of the recording techniques used to capture each instrument including, for example, the instrument being captured; the microphone type; and the microphone position[18].Also labelled are the structures of instrument sub-mixes and headphone mixes, which group related multiples of audio information. These annotations set apart the kinds of technical meta-information above and represents the musical and social make-up of the recording session with the instrument and musician's names. These are created in the real-time accomplishment of the production activities "instead of taking notes" both as a retrospective record of the configuration as it is created, and for prospective use in the recording activities.

The study also provides *new insight* into how annotations are archived to coordinate with potential future activities after the recording session. Digital labelling of audio tracks is preserved in DAW files, although some labelling applied in peripheral software is lost. Talkback audio is set up to be recorded to the DAW in sync with the multi-track audio, as a means to capture any artistic decisions made in real-time conversation amongst the members during the recording session that might be useful in future editing process. Finally, the physical labelling strips applied to the recording console are hung on the studio control room door, which the engineer does "just in case" he needs to refer back to details of the configuration in future processes, for an undetermined reason.

[18] A speculative analysis might conclude these metadata are useful for informing decisions in the mixing process, which was done after the recording session but not observed. Variations in microphone type and position can alter the tonal signatures of instruments and therefore how the recorded audio might be treated in the mix.

Providing for Flows of Work

Preparing Resources

In *addition to current knowledge*, the study of home studio production shows how the producer creates and manages an extensive library of sound files stored on the PC that hosts the DAW software. Preparing, managing and organising files into a folder system prospectively provides a key resource in the creative process that involves searching/browsing and auditioning sounds before importing them to the DAW as a compositional element. The producer groups files into folders labelled 'drums' or 'FX I always use' containing sound effects that the producer repeatedly uses on different songs to give a signature sound. The observations provide deeper insight into these organising practices through the producer's use of audio analysis software, aimed at DJs for managing song collections, to add metadata to the file names about tempo and key signature. This enables the producer to search for and retrieve sounds in certain key signature using the PCs native file browser, which he also uses to playback and audition sounds to be potentially included in the composition.

Structuring Audio Elements

Further *new insight* into organising resources surrounds metadata work done in the form of structuring audio elements. Similar to organisation of resources this provides for flows of work but is distinct in that *audio elements* are not necessarily restricted to sound files but include the tracks, channels and groups which contain or make up audio pathways. In the Home studio study, the producer brings about organisation of audio elements in the DAW before any real composition work starts, by creating 'busses' or sub-mix channel for drums, bass, effects and other musical elements, adding appropriate treatments to each in order to partially automate the overall music mix. For the producer this creates a musical "vibe" that facilitates a creative flow and gives an underlying structure to what is otherwise a largely experimental process in creating, layering and shaping sound.

In the recording studio study, *new insights* can also be found in how similar kind of structuring that groups related audio information together in the studio (see below) provides for the flow of work.. After setting up the recording equipment, the engineer creates a file in the DAW to template the configuration and capture the structure of the audio, the signal routing, the display order of audio elements, and the annotations in the labelling. This enabled the engineer to recall a properly configured DAW project file for each time the band moved on to perform the next song in their repertoire to be recorded. Further workflow provision from this structuring is detailed in the following.

Mapping Audio

Further *new insights* into metadata work can be found in the study of recording studio production and the process that the engineer undertakes to structure audio elements. The engineer draws upon the 'generic' metadata in the studio to connect and map audio in a complex arrangement of signal routes between pieces of the recording equipment. These metadata are embodied in the studio environment to support the engineer to route audio signals from a source to a destination, for example, microphone sockets in the live rooms wall boxes are numbered to correspond to one of thirty-two DAW inputs that they are patched to. The complexity of the mappings arises from the creation of sub-mixes, or sums, to aggregate audio from the multiples of microphones used to capture each instrument down to one set of controls; and even more complex mappings in the network of headphone and talkback audio. Each audio routing, then, is configured for a specific purpose and as such, also include the implementation of spatial organisation.

Spatial Organisation

In the study of recording studio production, spatial organisation is crucial to successfully coordinating the recording activities and in doing the setup the engineer draws upon labelling to route audio to and from specific positions in the studio. For example, the individualised headphone mixes were routed from the DAW outputs in the control room, via a patch bay, to wall boxes closest each musician in the live room. Spatial mapping is also implemented to group different categories of audio both physically on the recording console and virtually by ordering the display of audio elements in the DAW software. This is an important factor in how the engineer organises his flow of work and navigates the complex array of controls in the control room. For example, the network of talkback microphones used to communicate between the acoustically isolated rooms of the studio were positioned "out of the way" to channels positioned at the far end of the three-metre wide recording console; meanwhile the instrument sub-mixes are routed to channels within easy reach of the engineer's "listening position" for accurate monitoring of audio throughout the process.

Coordinating Work In-Situ

Visualising Musical Data

In the study of project studio production both the studies of home studio and project studio production the producers use analytical tools that variously produce graphic representations of loudness and/or frequency spectrum of audio information in real-time. These observations provide *new insight* into metadata work in the form of visual representations that are generated and used to "profile" individual sounds, the music mix, and reference material used to compare and contrast musical features of existing songs. These profiles provide visual support to critical listening activities that involve applying very finely adjusted treatments that are virtually impossible to assess through aural means alone.

Navigating Audio Elements

The metadata work to structure, label, and order audio elements principally aids members to navigate sounds assembled in the DAW and configurations of hardware and software controls. In the study of project studio production, the producer does a significant amount of metadata work to organise a composition and to provide future steps in the process. The producer also enhances the navigability of musical elements in the DAW with colour coding, in order to distinguish sounds as belonging to a group that makes up a musical part. Along with the structuring, labelling and ordering, this enables the producer to be able to work quickly to navigate the tens of layers of sound in the composition in order to perform the client mix.

Similarly, in the study of recording studio production the instrument and microphone metadata annotated to each audio channel provides for situated activities, for example 'sound checking' in which the engineer blends combinations of the different microphone tones used on each instrument to shape an instrument's sound prior to recording the performances. Structuring audio into instrument groups also aids the navigation of controls, giving the engineer a less granular view over the sound elements and provides for a smaller set of recording console controls that the engineer uses in the recording process itself to balance the overall music mix.

Coordinating Actors

In the study of recording studio production the situated metadata in the labelling is used in real-time to coordinate the flow of recording activities, again for the navigation of the complex array of physical and digital controls, but also to provide the contingency to respond to and coordinate activities with the musicians as they unfold. The musician's names recorded in the labelling, for example, enabled the engineer to navigate the complex matrix of headphone controls when individual musicians requested adjustments to the mix of sounds in their headphones. These metadata enabled the engineer to associate parts of the configuration with each musician and so tie technical elements to different social interactions.

Metadata Troubles

Abandoning Metadata Work

The study of home studio production provides further *unique insights* into metadata trouble. The producer draws upon metadata created to organise the local sound library resource to browse and audition sounds before importing and layering sounds in the DAW to build musical parts. The producer works quickly to do this and so largely abandons the kinds of labelling practices seen in the recording studio study, instead file names propagate through the process as tracks in the DAW inherit these when they are imported. This is part of an experimental process in which sounds can eventually be discarded as by-products and only once the sounds are layered, shaped and rendered as new sounds, might metadata labelling be applied to tracks as an organisational feature of the process. Here the producer falls back on spatial arrangement of sound layers on the timeline of the DAW as he creates sounds clips, as textual metadata in the form of track labelling, becomes difficult to use as an organising resource.

Reconstituting Metadata Work

Abandonment of metadata work also features in the study of project studio production and provides *additional insights* into how the producer recovers metadata work. In this study, on hand over of the artist's compositions in the form of DAW project files and folders, it becomes apparent that the artist's compositional approach largely abandons metadata work that provides for future production activities. The musical elements are only labelled with the default names that the DAW applies automatically, which are by and large, insufficient in recording and communicating information about the composition. To rectify this problem and provide for the proposed next stages in the production the producer must embark on a significant overhead of work to filter and audition ten of layers of sound, picking apart the musical composition and reasoning about how the musical elements should be reorganised.

Hiding/Deactivating data

In the study of project studio production, further metadata troubles are exposed in the handover of musical data that is potentially problematic for future processes. The artist applied automation data to the musical parts, which is 'drawn in' to the DAW graphical user interface to control audio effect parameters in synchrony with the music, for example raising the vocal volume in the choruses. The producer anticipates that these data are going to be problematic in the subsequent client mix process but lacks any information passed through from the previous stage as to why automation might have been applied. The producer then, has to go through a procedure of systematically inspecting and reasoning about what each instance of automation data is contributing to the composition and whether it may be deactivated and hidden. This is preferential to just deleting the data, as it preserves the option to reactivate automation and provides for any uncertainty in the producer's reasoning.

8.2.2 Summary

In this discussion, we have recapped on the motivations for focussing on metadata in modern music production as a potential resource that can add value to the music chain, and the need for observational study to better understand its creation and use to inform design. In addressing this research problem through observational field studies, music production metadata is identified in various forms: in the labelling physically written and displayed on the recording equipment; digitally in the use of labels, ordering, grouping and colour coding to organise musical elements in the DAW; in the audio annotations captured from talk-back alongside multi-track recordings; in the visual representations of audio generated by audio meters and analytical tools; and in the organisation of digital sound libraries.

The aim of this research goes beyond merely identifying metadata and toward understandings of just what these metadata *do* in the lived course of music-making activities. To reiterate, the observations contribute new insights to the role that metadata has in *documenting processes*, not through conventional notetaking but through annotations applied to audio elements in the form of both physical and digital text, and voice recordings. The metadata work done to *provide for flows of work* both adds deeper insights into organising sound files as a production resource, and new insights into *structuring and mapping* audio elements used in the production activities, and the *organisation of physical and virtual space*. New insights can also be found in the role that the subsequently displayed metadata plays in *coordinating work in-situ*, by aiding navigation of audio elements and controls; coordinating other actors engaged in an activity; and providing visual representations of audio that support activities. Deeper insights are also added surrounding *metadata troubles*, such as when metadata work is abandoned and subsequently requires reconstituting, but also provides new insight into metadata work done to non-destructively hide or deactivate potentially problematic data.

These observations contribute to shaping how music production metadata are conceptualised. Currently, metadata are largely considered as descriptive data about data, technically specified toward accommodating data exchanges in prescribed or recommended manners [2,8,73]. Metadata are also designed to support, among other functions, the storage, search, and annotation of data, however no one standard can sufficiently support the breadth of data requirements across the entire multi-media domain [199]. In the view of this thesis, this long-standing problem is symptomatic of the same issues of representation discussed in part 8.1 of this chapter: that standards "black box" work and effectively consign metadata as an object at 'level of transaction' [49]

is acceptable and even advocated in the commercial domain, there is a need to address the role of metadata in the real-time situated accomplishment of music-making work

In the view of this thesis, this approach is akin to issues surrounding standard process models that

. The studies then, reveal a deeper understanding of the role of metadata in music production and in the next section, these are taken up to derive implications for design which include contending with the issue of how to better the purpose metadata toward supporting situated activities.

8.3 INFORMING DESIGN

In this section, the implications for design are discussed, starting with a recap on some of the relevant features surrounding the social character of metadata as a resource in music production. Here the key metadata practices and challenges are identified and from these, three main implications are derived to better implement technologies toward: transitioning data between processes; preserving legacy metadata within and between processes; and capturing and aggregating multiple modes of metadata. These implications are then brought forward in contribution to design thinking to bring about flexibility in the use and reuse of musical data. Finally, in carrying out research in contribution to this thesis, findings have been disseminated and used in collaboration with researchers elsewhere and the impact of music research activities is summarised, which includes publications, technical workshops, and demonstrators.

This analysis leads us onto contribution 3, in which the value prospects and implications for design of digital technologies are discussed. Features of metadata work done in the course of music production are again drawn upon to derive a set of implications and design proposals that are rooted in the research data. It should be noted that in drawing up implications and proposals for design, it is not the intention of this discussion to provide full and comprehensive requirements specifications, as there is not sufficient space in this thesis to do so. The design suggestions are intended as a starting point for informing more complete technological development plans in potential future collaborations with systems designers. Finally, the discussion concludes with details of technical and conceptual developments so far derived from this work, and identifies potential future opportunities for research.

8.3.1 Metadata as a Resource in Music Production

To begin the discussion, we consider what has been learned from the findings about metadata as a resource in modern music-making; how it is created in the course of action and used to document and coordinate processes; and the troubles that can occur in its usage. The discussion then turns to what these observations mean for design and what potential solutions might look like and in particular how these implications contribute to the emerging concept of the Digital Music Object (DMO).

Annotation Practices for Documentation and Coordination

As we have seen in the discussion so far, documentation of music production activities is a task that is championed in the literature as essential for successful coordination of production process, however, the studies show that documentation in its prescribed form (see Figure 7 and Figure 8 on page 24) of is an overhead of work that is by-passed in favour of practical actions that advance the process. Assistant engineers conventionally take on the task of documentation as an aside from the process, however in many modern music-making scenarios assistants, among other traditional roles, are no longer common-place. Out of necessity then, documentation in its traditional sense has become a peripheral activity as digital production tools have streamlined modern music production practices and transformed actors' roles.

The studies reveal however that documenting practices are still undertaken in modern music processes but have transformed from the traditional notion of note-taking to metadata work done in the course of music-making activities. These metadata, in the form of annotations, provide both a retrospective record of activities, configurations of equipment, and structures of audio elements; and prospectively provide contingency for, and coordination with, future processes. The studies reveal the ways in which annotation practices provide for flows and the organisation of resources, including the organisation of sound files; structuring, ordering, and grouping audio elements; audio routing; and organisation of physical and virtual space. This organisation in turn supports in-situ activities, principally by aiding the navigation of audio elements displayed in the DAW and on the arrays of recording equipment. Further, the descriptive contents of annotations differ dependent on their proposed use, some contain shorthand descriptions of equipment configurations for the coordination of technical procedures such as recording or mixing, while others describe the social and/or musical make-up of the resources such as the musicians, singers or musical parts.

These metadata are in the main in textual form, entered in digitally to the annotation fields in the DAW and control software, but also physically written on recording equipment. Metadata of different modes are also created and used in-situ, to support the process. For example, in the home and project studio studies analytical tools are drawn upon to generate visual representations of audio to aid in decision making about shaping features of sound with audio effects. These visual aids are called upon for processing audio to change or filter a feature at fine-tuned levels that are difficult to discern using critical listening alone. Annotations are also generated in audio form. Talk in between song takes in the recording studio are captured alongside multi-track song recordings to log production decisions made in the course of the recording session.

Practical Challenges

As we have seen in the studies, the technological focus of modern music production largely centres on DAW software, which is designed to support a range of situated music-making from the inception of a song to its completion. DAW software allows relative flexibility in the way that musical elements and data can be organised, not only toward assembling and layering sounds in musical compositions, but to different orientations of work and uses of peripheral equipment. This tractability to a range of music-making tasks is arguably a strength that has led to the DAW's success; however, its weakness lies in a design deficit surrounding meeting the requirements for coordination between activities. The studies support this assertion and provide clear examples that show metadata work done to reconstitute musical data to a new orientation of work, is a required overhead in the transition between production activities.

In the study of recording studio production, the engineer undertakes a substantial amount of set up work, which includes creating metadata to organise the required musical elements and to support the recording of real-time band performances. In the overdubbing activity that follows, the engineer goes through a process of reorganising musical elements such that the musical information captured in the recording of each song can be reused in a new process. This involved repeating the manual process of adding and removing elements, for each of the songs recorded to the DAW, such as headphone feeds that are no longer required; new tracks created in preparation for recording and layering guitar and background vocals over the existing song recordings; and new groupings to aggregate musical parts to a sub-mix.

As seen in the Study of Home Studio Production, the producer assembles, layers and shapes sound from a digital sound library, which are then imported and assembled into a song composition in the DAW. From this process, metadata in filenames are of use in the sound library for searching, browsing, and auditioning, and propagates through to the DAW as annotations, which quickly become arbitrary to the new orientation of work: creating musical parts, shaping and mixing sounds and building the song in sections. This is not necessarily problematic to the in-situ activity of creating the song as the arrangement of audio elements in the virtual space, and an underlying structure of sub-mixes to group sounds are drawn upon to support this work. Annotation work is minimised in order to maintain the creative momentum to the flow of work, excluding the overhead of labelling up potential by-products of the process that are eventually discarded. Nonetheless this is metadata approach that is insufficient to coordinate with the follow-on process, creating an overhead of work for the producer to reorganise and reconstitute the musical elements and metadata in preparation for the 'stems' mix.

A starker example of this kind of transitional metadata work is evidenced in the study of project studio production, which evidences in more detail the character of the work

required to reconstitute song resources assembled in the DAW in preparation for upcoming stages of production. The song material that the artist passes over to the producer for development show indications of the kinds of arbitrary metadata work resulting from the home studio producer's composition work and which similarly leads to being reworked for mixing. In contrast to the home studio study, the producer speculates this is possibly due to the artist's inexperience of production work rather than a by-product of the creative process. Reworking the musical data involves a process of filtering, auditioning, restructuring, labelling and colour coding, informed only by the producer's reasoning about musical decisions that the artist might have made beforehand. The producer also reworks certain elements toward his own preferred method of working, for example, reconfiguring the application of sound effects to simplify the structure of sound elements for mixing; and colour coding instrument groups, while noting that his colour blindness highlights the requirements to cater for individual preference to locally organised practices. The automation data that the artist applied to elements of the song conflict with the producers preferred working methods, however rather than being discarded the producers reason that these are better to be deactivated and hidden 'just-in-case' these data need to be restored in a later process.

8.3.2 Implications for Design

From Troubles to Design Challenges

The features of the studies summarised above show that the coordinative character of music production metadata is rooted in two key factors: 1) Providing for future processes, including revisiting and revising activities, through retrospective-prospective annotations; and 2) Supporting the in-situ accomplishment of music-making activities through organisation of musical elements - how they are stored, arranged, mapped, labelled, represented and grouped in the physical, and virtual environment. For most music-making activities, the relationship between metadata and production work is mutually supportive, however these factors often compete at transitional points in the process, as illustrated in the processual challenges summarised above. These observations lead us to implication that there is a design opportunity to address the weakness in the DAW technology to better enable and support the transitioning between different orientations of production work.

To briefly recap. organisation of musical elements in the production process is largely left to the experience and methods of those engaged in production and their knowledge of how 'metadata work' supports both activities at hand and in future processes. If there is a significant conflict between these two factors, or this practice is abandoned altogether, whether due to inexperience of the creator, or necessity, there is often a significant overhead of metadata work in the transitions between activities to bring coordinative resources back to the process. The challenge for design is to exploit the

opportunities to reconcile these competing factors toward better coordination, exchange, and reuse of musical data across production processes.

Extending DAW Functionality to Include a 'Song Inspector'

Here, two solutions are suggested that expand the functionality of DAW technologies to address the coordination and exchange of musical data. Firstly a 'song inspector' aimed toward automating or partially automating the filtering, auditioning, annotation, and restructuring of musical elements to smooth and fast-track the hand-over of musical data. This function could provide the user with a paging dialogue that focusses on elements one at a time, such as tracks and groups giving options to automate auditioning contents, both in isolation and in context; discover relationships to other elements; include or make changes to grouping and structure; hide or deactivate data and effects; and make changes to labelling. This proposal also provides an opportunity to deploy audio feature extraction technologies in the underlying architecture and even extend functionality further to include discovery of song segments, such as introduction, choruses, and verses [104].

DAW plugin demonstrator

This concept is partially realised using instrument recognition software in a demonstrator informed by this research. The findings from the recording studio production study were presented to developers at a FAST project workshop in April 2016, using analytical resources tractable to design, such as workflow diagrams and storyboards. From this workshop a requirements specification was generated for a proof-of-concept software demonstrator, which proposed to automatically generate labelling of multi-track audio using instrument recognition algorithms. The design brief also required the generation of suggested labelling, potentially inferred from contextual data about common production practices. Although not yet fully functioning, project developers demonstrated a proto-type of the DAW 'auto-labelling' feature in December 2016 (Figure 71), which uses back-end service to perform audio feature extraction to recognise musical instruments and apply the returned result to the labelling for that audio element.

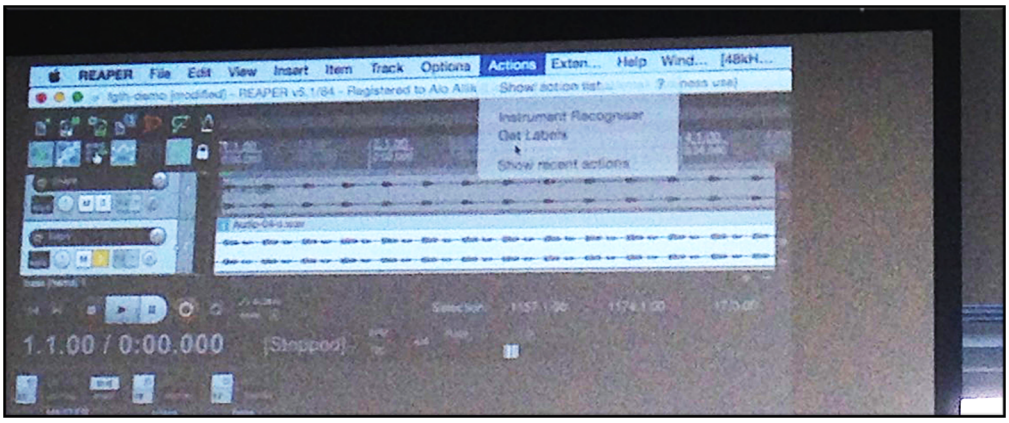


Figure 71 - Screen capture showing demo DAW auto labelling feature

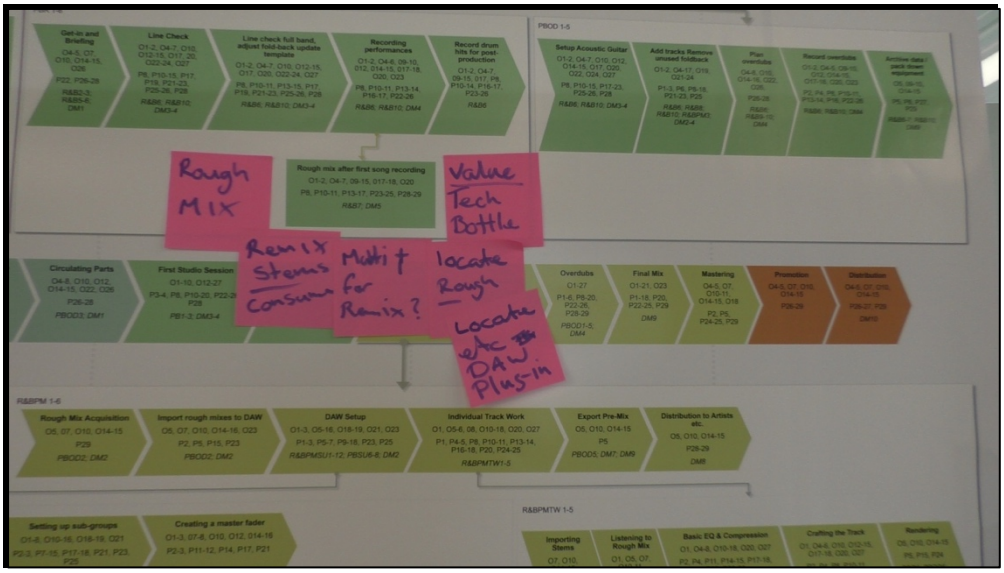


Figure 72 - Flow diagrams used to promote discussion with developers

Preserving Legacy Metadata

Clearly, both data and metadata go through transformations as sounds are captured, assembled, layered, and processed to form the end product of a song and presents challenges for the reuse of musical data. There is a requirement amongst work practices to pro-actively trace and record these transformations, to account for the 'just-in-case' factor, but which is not adequately supported in the technologies used. Currently, legacy data is usually preserved in DAW technologies using non-destruct editing and processing and work-arounds include saving versions of DAW project files. While this represents what might be considered good practice, it breaks away from the flow of music-making which requires, as the producers in the home and project studio stated respectively, "getting the vibe going" or "getting your ear-in" and tuning into the creation of an artistic product.

Extending DAW Functionality to Include Process Tracking

The challenge for design then is to preserve legacy and provenance information, such as the recording techniques inscribed in annotations or the origins of sounds shaped from resources in a sound library, in a way that is opaque to actors involved in the process. This in turn might preclude the overhead of version management while giving the affordance to revisit a process and revise its results. For example, an extension to DAW functionality based on this underlying metadata capture might provide the facility to 'roll-back' a musical part or a stem track to disaggregate, inspect and revise the composition of layers and effects that might have previously been rendered to preserve processing power.

Capturing Different Modes of Metadata

A final key implication is that metadata is a multi-modal phenomenon and to recap, the studies show that in music production these include textual inscriptions on recording equipment, for mapping audio signal paths; textual annotations in digital and physical form to document and navigate the configuration of audio elements; colour coding to categorise and group audio elements; graphical representations to aid editing and processing tasks; and audio annotations to log real-time production decisions. Digital text and colour are of least concern to the design of computing systems, nonetheless other modalities present a design challenge for capturing and preserving valuable metadata and potential solutions might be offered through the affordances of multiple technologies.

Methods of Capturing Multi-modal Metadata

Mobile technologies enabled with image capture and network connectivity, could be paired with character recognition technology to potential scan physical inscriptions to be converted to configuration metadata. Images could also be leveraged to capture microphone positions or settings on analogue equipment that could then be incorporated in the digital metadata surrounding a musical resource, to ease the overhead of documenting to paper. Also, although a relatively niche requirement in the amongst the range of work practices present in the studies, voice recognition and transcription technologies could also be leveraged to convert spoken annotations captured in talkback, which could, albeit speculatively, be useful to later processes. Just how these multiple modes of metadata might be aggregated and integrated into music production systems is addressed in the following section.

8.3.3 Toward DMOs (Digital/Dynamic Music Objects)

A potential technical component in the design solutions offered above lies, in the emerging concept of the DMO (Digital Music Object), which is a metadata form that proposes to "enable(s) ease of reuse and remixing of music right through the chain from composition to consumption" [185]. This fundamental requirement is directly reflected in the findings, as actors involved in music-making make the resources they use tractable to a range of music-making activities through treatments in their real-world, real-time work practices. These resources translate as 'musical objects' in the DMO concept and in identifying the opportunities to intelligently trace and manage musical objects and make them malleable to other processes, there also lies an opportunity to exploit, contribute to, and extend DMO requirements.

The DMO is derived from the concept of research objects, aimed at capturing scientific workflows for future researchers to potentially reproduce, revisit, remodel, and reanalyse findings [184]. Research objects can also simply be a collection of URLs that can refer to research data archived in any format, for example video, text, imagery, or catalogues of physical artefacts, making them shareable as a social object for recording, evidencing, and disseminating the outcomes of research work. The DMO incorporates and extends these ideas in the design of novel, metadata driven music technologies that so far have focussed on the domains of performance [130,131,221], dynamic listening experiences [99,207,208] and audio processing [167]. These concepts also have application in answering music production requirements set out above. Per the requirement to preserve legacy metadata, DMO could be leveraged as a mean to capture workflows and intelligently trace the transformation of music objects such that processes can be retrospectively revisited and reproduced. Per the requirement to capture multimodal metadata such as the audio annotations and images, DMOs could be a suitable means to aggregate and integrate these digitised resources alongside other digital music data to preserve valuable production information that may otherwise be lost in the process.

The requirement to better transition musical data between processes, however, requires some extension of the DMO concept as the underlying metadata framework, in order to potentially realise the kinds of functionality in the proposed integration of a 'Song Inspector' into DAW technology. This contribution to the DMO is realised more fully in a published paper that includes findings from the studies featured in this thesis, and which is discussed next in order to continue the discussion.

The Concept of a DMO

Findings from the study of recording studio production contributed to a paper published in the proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW) [154]. The paper uses findings from this and one more field study conducted by Peter Tolmie, in which the issue of transitioning between processes is discussed and the overhead of work to reason about metadata from a previous process and reorganise it toward a new process. These findings contribute to the DMO concept which is summarised in the following extract:

> "Our first contribution is to extend DMOs with multiple 'shells' of metadata, each of which supports a particular individual performing a particular task as part of a wider workflow. Thus, an individual engineer undertaking a recording session may create and temporarily invoke a metadata shell that maps the DAW interface to the labels, colours and so forth that they require right now for the task of recording. This may be distinct from a shell that they subsequently invoke for creating a rough mix and different again from the shell that another engineer might invoke for recording or mixing (Figure 73). The key idea here is that these metadata shells can be readily picked-up and set-aside to configure a DAW to a specific task."

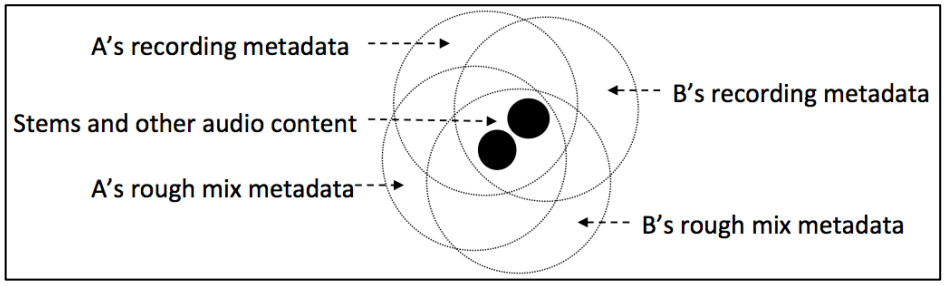


Figure 73 - A DMO with multiple metadata shells

The presentation of this paper was seemingly received well by the CSCW community, as music production is a relative unique area of study in this field, however the concept of 'shells' may need some further elaboration. An alternative analogy for the concept might be to think of how style sheets are used in web pages to present content in different ways, whether for mobile or desktop devices, or through accessibility requirements. In this approach the underlying data, semantically marked up content types, remain as if they were constant and it is only through 'reskinning' using style sheets that determines how that data is presented. Similarly, the metadata shells might enable different end users to impose their own mappings, labelling, colour coding, groupings etc. to the underlying data. For example, in the recording studio study, the transition between recording and overdub activities could have been facilitated far more smoothly through the templating and subsequent application of a 'shell' in order to map the underlying data to a new configuration of musical elements. To this end the paper proposes four key properties of shells that extend the DMO concept toward implementation as a social object in music-making practice. In short shells should be switchable, to apply/hide audio configurations; transferable, to pass shells between

processes; editable, to adapt and create new shells; to discoverable, to explore other's configurations.

8.3.4 Limitations of the Studies and Future Work

In the final part of this discussion, the limitations and scope of the research are considered. Firstly, the studies do not capture the entire music production landscape. There now exist a vast breadth to the possibilities for music production scenarios and it is simply impossible to exhaustively study every possible iteration. The three study scenarios were targeted that span the spectrum of modern music-making methods from the capture of real-world instrument performance to exclusively 'in-the-box' virtual production. As discussed in Chapter 4, gaining access to study music production scenarios is particularly challenging but even in surmounting these the entire scope of modern music production cannot realistically be exhaustively captured. Secondly, the focus of these studies has been surrounding metadata as an organising resource which has overlooked the opportunity for musicological analysis of how songs are put together. Musical parameters such as: key signature, tempo, musical arrangement, or musical genre etc in any real detail.

Nonetheless, the studies do uncover a generalisability to the work practices of music production that can feasibly be taken up in the kinds of contributions above. Crabtree et al [50] illustrate that in observing ethno-methods to explicate the ordinary nature of a setting's work and in understanding their reflexive organisation in their accomplishment of a particular occasion generalisations may be sought. The "machineries of interaction" are embodied in the very doing of sociality and are recognisable as such by parties to the work and observer of the work who are suitably competent in recognising its ordinary nature.

> "A single case of the machinery of interaction at work on any particular occasion is generalisable because it is a shared cultural resource for arranging the everyday affairs it elaborates. It is in this sense that activities may be said to contain their own means of generalisation."

It is through the chosen method of study then, that the result from a relatively small but sufficient amount of field data that the generalisable features of music production work may be gleaned. That is not to say that study of this domain stops here, on the contrary, as listed above there are many other opportunities abound for future work, particularly in the domain of technologically supported distributed/remote collaborations, in hybrid real-world/virtual production scenarios, and in the domain of live performance. There are also opportunities to explore how musicological parameters and artistic decisions shape the more subtle aspects of processual organisation and the implications these have for design, and the potential value of musicological and technical information for consumer interest.

Chapter 9
Conclusion

In this thesis we have explored the motivations for the research, which is rooted in the role of digital technology in the radical transformation of the modern musical landscape: The "mp3-crisis". The devastating effect of illegal file sharing and affordable production tools undermined the music industry's business models and its revenues and decimated the recording studio sector. In the wake of the mp3-crisis, however, many opportunities have arisen and solutions to the requirements of the digital supply chain and novel applications of technology for interacting and consuming music have been prolific, in particular the recent development of metadata concepts and their applications. In the music production domain however, there are fewer of these recent developments despite the existence of underlying metadata concepts for describing workflows and for enriching musical metadata through the extraction of music features from audio data. Despite the readiness of these opportunities to be exploited, the application of these technologies requires designers to understand the nature of work practices in music production, in order to deploy technologies that support processes effectively. However, music production has not only traditionally been inaccessible to outside empirical inquiry due to the perceived threat to skills competition and commercial and artistic sensitivities, but in the post-mp3-crisis world music production has branched out and diversified far beyond the traditional centre of production, the recording studio.

As verified in a survey of the literature in Chapter 2, understandings surrounding *modern* music production then are thin, so too are understandings of the role of metadata in work practices that can potentially be exploited to add value to the music value-chain and drive novel applications. In response to this knowledge gap This thesis raises three research questions:

1. How is music production organised in the "post-mp3-crisis" world?
2. What is the role of metadata in the social organisation of music production?
3. What are the implications of metadata's organisational production and use for the design of music production technologies?

To address these questions, the research approach taken was to conduct empirical studies of music production consisting of detailed fieldwork to examine the accomplishment of music-making activities processes and the creation and use of metadata within them. This approach is in-line with the tradition of 'design ethnography' in the field of HCI and is highly appropriate to the problem space as

field workers can ‘get inside’ the work of a setting to develop first-hand knowledge of its working practices that can be reported using methods that are tractable to design.

The three study scenarios detailed in Chapters 5-7 attempted to provide a broad view of music production activities and which notably reflect the characteristics of the post-mp3 musical landscape, as explored in Chapter 2. A study of recording studio production observes a semi-professional band who make an income from live performances of classic rock covers and who collaborate with a recording engineer to capture studio recordings of their repertoire. In a study of home studio production, the producer is the creator and engineer of the music, working within a collaborative network of business and artistic associates whose core revenue is from DJ performance that are closely linked to production practices. In a study of project studio production, the producer is the collaborative linchpin of a musical project and who provides a diverse set of skills to engineer, give artistic direction and contributions and coordinate the process.

All three studies observed the music making activities in-situ and in Chapter 8 we discussed the contributions from the findings in addressing the research questions.

1. The findings demonstrate that modern music production is organised within a flexible and broad ranging set of production activities, which in turn suggest that standard theoretical process modelling as a means to represent music production work and posits that this approach no longer makes sense. Instead this thesis recommends that the focus of inquiry should turn to the ad hoc assemblages of locally adequate practices, particularly in pursuing insights to inform systems design.
2. The findings contribute to Understanding the Role of Metadata in Music Production and in discussion we considered the properties and characteristics of metadata identified in the studies, not as a technical concept but as a resource in music production. This includes its role in annotation practices for documenting, and organising musical elements, but also its coordinative role in prospective processes and in the in-situ accomplishment of music-making activities.
3. We drew implications for design from the findings and identified areas of potential impact on design thinking including metadata-driven extensions of DAW functionality and a contribution to the specification of Digital Music Object (DMO) which are conceptually aimed toward packaging musical data for exchange, use, and reuse across the music value chain.

Finally, we discussed the limitations of the studies and identify that while it is possible to sufficiently derive generalisations from the observed work practices of the setting, there are further opportunities for work in this area to study how technology is appropriated to support distributed collaborative practices, of mixed real-world/virtual ‘in the box’ production scenarios, and the coordination of production practices with

live performance. Also identified is the opportunity for deeper musicological analysis of production practice to investigate more subtle and detailed practices and decision making in production and the potential value for consumer interest that these have in representing the artistic and creative process.

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Appendix

Consent Form
and Ethics Approval

Appendix

Information Sheet & Consent Form

The University of Nottingham

Objectives of the research: The research seeks to understand the activities, resources and practices involved in music production and consumption in order to inform the development of next generation digital technologies.

Data to be captured: The study will involve observations of the activities ordinarily involved in music production and consumption, along with informal interviews with participants, to understand how music production and consumption is practically accomplished. The researcher would like to record data to support subsequent analysis of these activities, including notes, photographs and audio/video recordings.

Use of the data: The data will be used by the researcher to address the objectives of the research. The raw data may be used in project workshops. Anonymised transcripts of the data will be used in scientific reports, presentations, and publications.

Reuse of the data: Consent for reuse of the raw data will be sought by the researcher prior to reuse taking place.

Who has access to the data: Direct access to the raw data is limited to the researcher. Extracts of the raw data may be presented at project workshops but will not be copied or shared. Anonymised transcriptions of the data may be shared across the project.

Storage of the data: The data will be stored securely in accordance with the 1998 Data Protection Act on a password-protected computer and be backed up on an encrypted hard drive secured under lock and key at the University of Nottingham.

Your rights: Participants are free to withdraw from the research at any time without explanation and their data will be erased. Participants have the right to access their data at any time, and request that their data be destroyed. The researcher can be contacted on:

Glenn McGarry
School of Computer Science, Jubilee Campus, Wollaton Road,
NG8 1BB Nottingham, UK.

07967960988

glenn.mcgarry@nottingham.ac.uk

Participant Consent (please tick as appropriate)

Participants must be 16 or above; all participants ***must*** sign this consent form.

❑ I have read and understand the information sheet, which includes information about the data to be recorded, the purposes it will be used for, and who access to it.

❑ I understand how the data will be stored, my rights, and that I can withdraw from the research at any time by contacting the researcher at the address provided above.

❑ I confirm that I am over the age of 16.

I consent to the following types of data being recorded (please tick as appropriate):-

❑ Notes ❑ Audio recording ❑ Video ❑ Photographs

If you have agreed to video or photographs being recorded, please indicate your consent to the potential use of visual images that may identify you in scientific reports, presentations and publications:

❑ Identifiable visual images can be used in scientific works

Participant's Details:

Address: _____

Name: _____

Signature: _____

Date: _____

School of Computer Science Research Ethics Checklist for PGR students & staff

- This checklist must be completed for every research project that involves human participants, use of personal data and/or biological material, b*efore* potential participants are approached to take part in any research.
- Any significant change in the design or implementation of the research should be notified to cs-ethicsadmin@cs.nott.ac.uk and may require a new application for ethics approval.
- It is the applicant's responsibility to follow the University of Nottingham Code of Research Conduct and Research Ethics and any relevant academic or professional guidelines in the conduct of the study. **This includes providing appropriate information sheets and consent forms, and ensuring confidentiality in the storage and use of data.**
- Completion of this form confirms that you have read and understood the guidelines at www.cs.nott.ac.uk/ethics regarding:
  - what is defined as *personal data;*
  - what is required for *valid consent;*
  - the key requirements of the Data Protection Act
- The supervisor/principal investigator is responsible for exercising appropriate professional judgement when completing Section VI of this form.
- **Sections I to V should be completed by the student or researcher undertaking the study. Section VI should be completed by the supervisor/principal investigator.**
- The **supervisor/principal investigator** is responsible for emailing the completed form to cs-ethicsadmin@cs.nott.ac.uk, and for providing feedback to the student/researcher.

SECTION I: Applicant Details	
1. Applicant's name	Andy Crabtree
2. UoN Email address	Andy.Crabtree@nottingham.ac.uk
3. Status	Staff
4. Student ID (PGR students only)	
5. Supervisor/PI's name	
6. Supervisor/PI's email address	

SECTION II: Project Details	
1. Project title	FAST (Fusing Audio & Semantic Media) – Ethnographic Studies
2. Proposed start date and period of study	25-02-2015 to 30-06-2019
3. Is this a re-submission?	No

4. Description of Project, including aims and objectives. *Please include any information which may affect the consideration of the ethics involved, eg location of study, unusual circumstances, age range of participants:*

The FAST project (EPSRC Programme Grant EP/L019981/1) is exploring the potential to fuse audio and semantic media. This proposal relates to long-term ethnographic studies of music production and consumption in everyday life to inform the development of new technologies of production and consumption within the project.

The studies will be conducted in a range of social settings including the home and professional settings. Specifically, the proposal relates to conducting the following studies:

Music production in home studios (professional and amateur)
Music production in professional studios
Music consumption in professional studios (e.g., radio)
Music consumption in the home
The promotion of music in amateur and professional settings
Life music performance

The studies will be conducted by senior researchers in the MRL with long track records and experience of conducting ethnographic research in domestic and professional settings. Should early career researchers take part in the studies they will be briefed on appropriate research practice by senior research staff as per the university's Code of Research Conduct. The research will also be conducted with respect to the British Sociological Association's ethical guidelines: http://www.britsoc.co.uk/about/equality/statement-of-ethical-practice.aspx No children will be involved in the study.

4. Will personal data or biological materials be collected, recorded and/or analysed?

Yes

If Yes, please give details of the data or materials and the methods to be used and describe how safe storage will be maintained according to the Data Protection Act:

With participants' consent, the data collected will include video and audio recordings documenting the mundane activities involved in music production and consumption across the various settings listed above. The raw data will be stored on password-protected computers and backed up on encrypted external hard drives secured under lock and key in UoN offices. The raw data will not be placed on the UoN network or Internet. Transcribed data, which will be used in reports, presentations and publications, will be anonymised. Consent will be sought for the use of identifiable visual images of individuals. Participants will also be informed of their right of withdrawal and right of access to their data.

SECTION III: Research Ethics Checklist (Part 1)	
Please answer all questions:	**Yes/No**
1. Does the study involve participants who are particularly vulnerable or unable to give informed consent (e.g., children, people with learning disabilities, prisoners, your own students)?	No
2. Will the study require the co-operation of a gatekeeper for the initial access to the groups of individuals to be recruited (e.g., students at school, members of a self-help group, residents of a nursing home)?	No
3. Will it be necessary for participants to take part in the study without their knowledge and consent at the time (e.g., covert observation of people in non-public places)?	No
4. Will the study involve the discussion of sensitive topics (e.g., sexual activity, drug use)?	No
5. Will participants be asked to discuss anything or partake in any activity that they may find embarrassing or traumatic?	No
6. Is it likely that the study will cause offence to participants for reasons of ethnicity, religion, gender, sexual orientation or culture?	No
7. Are drugs, placebos or other substances (e.g., food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
8. Will body fluids or biological material samples be obtained from participants? (e.g., blood, tissue etc)	No
9. Is pain or more than mild discomfort likely to result from the study?	No
10. Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?	No
11. Will the study involve prolonged or repetitive testing for each participant?	
12. Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants?	No
13. Will the study involve the recruitment of patients, staff, tissue sample, records or other data through the NHS or involve NHS sites and other property? If Yes, NHS REC and R&D approvals from the relevant Trusts must be sought prior to the research being undertaken.	No

SECTION III: Research Ethics Checklist (Part 2)	
Please answer all questions:	**Yes/No/NA**
1. For research conducted in public, non-governmental and private organisations and institutions (such as schools, charities, companies and offices), will approval be gained in advance from the appropriate authorities?	Yes
2. If the research uses human participants, personal data or the use of biological material, will written consent be gained?	Yes
3. Will participants be informed of their right to withdraw from the study at any time, without giving explanation?	Yes
4. If data is being collected, will this data be anonymised?	Yes
5. Will participants be assured of the confidentiality of any data?	Yes
6. Will all data be stored in accordance with the Data Protection Act 1998	Yes
7. Will participants be informed about who will have access to the data?	Yes
8. If quotations from participants will be used, will participants be asked for consent?	Yes
9. If audio-visual media (voice recording, video, photographs etc) will be used, will participants be asked for consent?	Yes
10. If digital media (eg computer records, http traffic, location logs etc) will be used, will participants be asked for consent?	Yes
11. If the research involves contact with children, will the researchers have appropriate CRB checks?	N/A

- If you have answered 'No' to all questions in SECTION III Part 1 and 'Yes' to all relevant questions in SECTION III Part 2 the project is deemed to involve **minimal risk** - go to the signature page.

- If you have answered 'Yes' to any of the questions in Part 1 or 'No' to any of the questions in Part 2 the project is deemed to involve **more than minimal risk**. Please explain in SECTION IV why this is necessary and how you plan to deal with the ethical issues raised.

SECTION IV: If the project involves more than minimal risk, please explain why this is necessary and how you plan to deal with the ethical issues raised

Copyright infringement may be observed in domestic context for personal use. As this is a civil matter under UK law the risks accompany this are deemed low to participant and researcher and tractable through the process of informed consent and the treatment of participant's personal data in accord with BSA guidelines.

RESEARCH ETHICS CHECKLIST – SIGNATURE PAGE

SECTION V: Applicant Declaration	
Please confirm each of the following statements:	Yes/No
The project is deemed to involve minimal risk as defined in SECTION IV	Yes
I confirm that I have read the University of Nottingham Code of Research Conduct and Research Ethics	Yes
I confirm that I have read the guidance documents listed on page 1	Yes
I confirm that the information provided in this application is correct	Yes
Signature of applicant*	Andy Crabtree
Date	19-02-2015

SECTION VI: Supervisor/PI Declaration	
Please confirm each of the following statements:	Yes/No
The participant information sheet or leaflet is appropriate for this research project**	
The procedures for recruiting participants and obtaining informed consent are appropriate**	
The data collection and storage methods are in accordance with the Data Protection Act	
Signature of supervisor/PI*	
Date	

** For email submission, please type your name in place of a signature.*

***All applications for projects involving human participants (or their tissue) must be accompanied by an information sheet and consent form.*

- The **supervisor/principal investigator** is responsible for emailing the completed form, together with any information sheets and consent forms, to cs-ethicsadmin@cs.nott.ac.uk.
- The **supervisor/principal investigator** is also responsible for providing feedback to the student/researcher following Ethics Committee consideration.

SECTION VII: For completion by a School Research Ethics Committee Member	
Name of REC member	
Comments or suggestions	
Decision	**Approve** **Revise** **Reject** (delete as appropriate)
Signature of REC member	
Date	

On completion, an email confirming the decision should be sent to the **supervisor**/**principal investigator** with a copy to the student/researcher. The completed form will be kept by the School Office.