Building Materials: an installed composition

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Abstract

This research project extends my creative work and unpacks my interest in the use of sonification and mapping as compositional strategies, both in my own practice and more broadly. The thesis reflects on the installed composition, *Building Materials*, synthesising a methodology for the creation of similar works by exploring research problems arising from its creation. The thesis considers the tension between the apparently objective process of mapping and the personal, intuitive, nature of creative practice. This tension establishes a space of uncertainty into which viewers can respond imaginatively to a work built on unseen mappings, granting an audience a sense of the sonified phenomenon.

These themes are discussed, and two discrete terms are arrived at: *installed composition* and *reverse mapping*. The first contextualises my practice with a descriptor that can help an audience usefully situate the work and by extension others similar, while the second proposes a model for reading work made using these processes that centres on the relationship between the actual mapped phenomenon and a speculative version in an audience's mind.

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Images

[Some images have been redacted in this digitized version due to potential copyright issues]

Introduction

This research project as a whole – practice and thesis – extends my creative work and unpacks my interest in using the processes of sonification and mapping as compositional strategies, both in my own practice and more broadly. It introduces *Building Materials*, my installed composition first shown at the Exeter Phoenix in 2010. The thesis explores the work by uncovering the research problems addressed by its creation. These are then synthesised into a broad methodology for the creation of similar work based on sonification.

Building Materials uses as its source material the sounds and events that take place within the building in which it is installed. As a composition it exists as a complex set of instructions made manifest by a program written in Cycling74's Max. These instructions compose what is heard according to data gathered from microphones and sensors dispersed through a building. This data tells the work how to act on each one of the eight live audio streams which are gathered into the work from the building, and, once the work has acted, the resulting composition is output to a listening space, set apart from the active space of the building from which the data is harvested.

The first chapter of the thesis presents the context for *Building Materials*. It begins by setting out the research problems tackled by the work and goes on to contextualise a number of these problems, and *Building Materials* as a work, within my own practice. There follows a section discussing the contemporary context for the work which serves to situate the work and to draw out its contribution. Then the chapter opens out to explore the broader fields inhabited by the work, enabling a more accurate description of its particular field.

Moving on from this contextualisation, the thesis will set out the principal methodologies pursued in this research. Firstly the chapter sets out the research methods and how they address the questions arising from my work. It then goes on to contextualise the research process within the broader context of practice-based research. Following on, the chapter outlines the methodologies used in the creation of *Building Materials* as they arise from the research problems. The chapter then considers the ways in which sonification and mapping are fundamental to *Building Materials*. Both practices will be explored with the understanding that the two are intrinsically linked, with mapping being one of the core methodologies within sonification (Hermann et al., 2011). The section on mapping extends this discussion of the

way we receive the proceeds of a sonification, focussing on the cultural role of the map, and the semiotic confusion surrounding maps and, by extension, sonification. The final section of the second chapter sets out the way in which the idea of storytelling is used in this thesis.

The next chapter examines *Building Materials* as the practice on which this research is based. It details the methods behind its creation, examining my praxis and exploring the tacit knowledge gained during its gestation and creation. The process of selecting sound sources, both for their sonic qualities and their potential for data gathering is considered and followed by a discussion of the way in which my musical form was uncovered within, extracted from and imposed upon, the sound sources. The processes within the software are then described, as are the practicalities of installing the tape and microphones. Finally I detail the way in which my interest in sonification as a compositional methodology grew from my professional practice as a composer and sound designer for interactive media.

The final chapter sets out and explores the terms *installed composition* and *reverse mapping*. It draws out the additional texture that the former adds to a work, and interrogates them both through for their usefulness. It then goes on to consider some of the broader implications of this research project for my personal practice. It expands ideas around interactivity in an attempt to unpack what it is about the *Building Materials'* relationship with interaction that I am particularly drawn to. The final, short, section considers my relationship to the role of composer, exploring the way in which sonification has modified my role in my music to the extent that I am sometimes simply a bystander, with little to no moment to moment agency within my work. But my agency within the work, as it composes itself in the moment, is replaced by the managed agency of others. This has fascinating implications for my relationship to the structure of a work as well as the audience's apprehension of its story.

The thesis as a whole, therefore, introduces new knowledge in different ways as the research methodology develops. During the process of producing *Building Materials* the artwork new tacit knowledge was gained through my praxis; by doing things I learnt new things. This is unpacked and set out as new procedural knowledge. There is also the tacit knowledge gained, by an audience as well as myself, when experiencing an artwork, what Iain Biggs calls 'non-verbal intelligence' (Biggs, 2006). The second method for the exploration of new knowledge is

through unpacking the tacit knowledge gained by the audience in the installation, by exploring the tacit knowledge that *I* gained. This reflexive process, considering my work and the outcomes of my work, leads to new knowledge in the form of new conceptual and methodological frameworks.

Chapter 1

Contexts

1.1 Introduction

The context for this research is defined by the research problems that drove the process of making the work as well as being defined by the form taken by the final piece. This chapter will firstly outline the research problems and go on to describe how they have been present in other works I have made, thereby linking *Building Materials* to my wider research and professional practice. The chapter then goes on to situate *Building Materials* within the contemporary field, drawing out the contribution made by the work. Following this, the chapter opens out to explore the broader fields inhabited by the work, situating *Building Materials* with reference to sound art, composition, interactive art and design and installation art. This in turn allows me to triangulate a more specific field for my work than that of simply sound art.

1.2 Research problems

The problems addressed by this research arise from the proposal I made to the commissioning body at Exeter Phoenix. They amount to the broad question of how a piece of music can be made from a building, but it is useful to pick at the threads within this question.

One of the first problems that arose when considering the question of how to make music from a building was one of form. In this instance the question was broader than one concerning moment to moment musical form. It needed to address the fact that the work was to be exhibited for a month in a gallery. This posed the problem of showing a time based work in an environment where audience entry and exit times would not be fixed. This as, well as my interest in open works, was a determining factor in the decision to make a piece that was composed in the moment. Once this decision had been made, and the proposal for *Building Materials* accepted by Exeter Phoenix, a series of new problems presented themselves. These problems form the bulk of this research and are listed below.

- What sounds and data will drive the moment to moment realisation of this month long composition?
- How will the sounds and data be harvested?
- Where will the work make contact with the building, and what are the criteria for making this decision?
- How can the model of interaction be balanced so that there is audience agency within the work but the work still sonifies its setting and not itself?
- How can this more subtle model for interaction be communicated within the work?
- How can I achieve my stated goal of producing a composition that fits within my desired aesthetic?

1.3 *Building Materials* within my practice

Sonification, interaction and generative composition that is realised in the moment are themes that have driven my research and professional practice since I first started working with sound and interaction in 1998. Since then my practice has explored differing models for creating open work that have inhabited various disciplines. Online works, physical installations and experimental films have all been mined for their compositional potential within these themes. Three of these pieces will be outlined below in order to demonstrate the conceptual and practical paths that led to *Building Materials*.

The first iteration of my own portfolio website, *www.repeat-to-fade.net* (Poeser & Lloyd, 2001), is an example of an online compositional model with a nuanced approach to interaction. It is discussed in greater depth in section 3.6 but outlining it here provides a good jumping off point for discussing the following works. The site was an information resource for potential

clients to discover my work. The music that accompanied the experience of browsing the site was structured, using short sound files taken from my compositions, entirely by the on screen actions of the user. In essence it was a musical sonification of their search for information within the site. But the interface was also playful and, with regards to the rules of the compositional model, learnable. This meant that the subject of the sonification would change according to the current focus, either musical or information gathering, of the user's interactions.

The use of different modes of interaction combined with sonification was developed within a physical setting with *Motomotion* (AllofUs, 2005). *Motomotion* was a 20 foot LED wall which captured and displayed the image of its users dancing through a 24 frame animation. This 24 frames of dance was the principle, direct, user interaction with the work. Once captured, this interaction was analysed, along with the indirect interactions resulting from the user's height, size and the colour of their clothing. The resulting data generated both graphics and a unique music loop, generated within a Max patch, that accompanied the dancing animation down the length of the wall.

A key element in both of these pieces is the open nature of their realisations. *I am a Painter* (Lloyd, 2010) explored this further and added a visual component in the form of an aleatorically constructed film, programmed in Max. The film was pieced together from fragments from my grandfather's cine films that were separated into their red, green and blue components. The work then played these back in three separate modules that ran out of phase according to a ruleset. The three resulting films were mixed together to make one moving image that blended the out of phase red, green and blue films resulting in an aleatoric colour mixer. The accompanying sound was created by analysing the film's final output and modulating the pitches of simple waveforms that accompanied each colour; sawtooth for red, sine for blue and pulse for green.

These three works, as well as *Building Materials*, all manifest my interest in indeterminacy, extra-musical inputs and sonification. The works are also all in a constant state of creation, in permanent flux. They all depend on active input, the working through of a complex ruleset, or extra musical events to make themselves in the moment. *I am a Painter* particularly shares

with *Building Materials* the problem of how to create a time based work that will be installed rather than played through at a set time. Works like this are encountered by an audience mid flow, they have already started and they will end after the audience has left. This means that the usual narrative and structural arcs of film and music are unavailable to the artist. *I am a Painter* addresses this by having an open form that is decided by rules that ensure the work never repeats. What is seen and heard of the work in situ is only witnessed in that moment.

Both *repeat-to-fade* and *Motomotion* share with *Building Materials* a nuanced mix of direct and indirect interaction. The data sets that create their musical content contain information that is focussed on this content – for example the initially captured dance in *Motomotion* – as well as information with a genesis outside of the creation of music – such as the colour of a user's t-shirt. The communication of this active/passive interaction model within *repeat-to-fade* was helped by the playful nature of the interface. The interface could be used as a kind of musical toy, but the toy was also the route to information and so the duality of its role as an interface became apparent.

1.4 Situating *Building Materials*

Having positioned *Building Materials* within my own work, I will now situate the piece within contemporary practice. It engages with a number fields principally comprising composition, sonification, interactive art and installation. I will discuss a number of contemporary works which share some of the same territory, but the space inhabited by *Building Materials* sits in the intersection of all of them.

The first of these is *Listening to the Building* (2010) by Ian Baxter. In email correspondence he reveals his approach. Time was spent roaming the Bank Street arts centre in Sheffield with contact microphones and a digital recorder searching for interesting sounds. Microphones were then placed at these points and the sounds fed directly back to a listening space. Unlike in *Building Materials* these sounds were left untreated and there was no visual component. *Listening to the Building* moved the sounds from the realm of the physical to the acousmatic and presented them to its audience (Baxter, 2011). The link between *Building Materials* and *Cityvoice*

(2010) by Splace is more of a visual one. An architectural practice in Genoa, Splace recorded sounds from the city and its surroundings, the wind and sea, traffic, marketplaces, and then played them through sets of headphones, within the Palazzo Ducale. There was no realtime link and again the sounds were presented raw and unmediated, almost as documentary evidence of the cities' sonic character. The architects had strung dozens of wires, throughout the building, leading out to the street where they cascaded over a balcony like a waterfall. The visual effect was striking, a web of colour inviting investigation and play (Splace, 2010). However in this instance play had no effect on the realisation of the work which had more in common with Bill Fontana's curated re-presentations and re-contextualisations of existent sounds.

The Place Where You Go to Listen (2002-6) is an installed composition by John Luther Adams, at the University of Alaska Museum of the North in Fairbanks, Alaska. The work is composed in real time according to data from geological, seismological, meteorological and geomagnetic stations around Alaska. These stations deliver data about earthquakes, the weather and the aurora. The work also tracks the paths of the sun and the moon, bringing all this information together in a composition that sonifies the landscape, the yearly cycles of day and night and even the skies above (Adams, 2009). Adams uses sonification to generate his music but here the viewer is left outside the process. There is no interaction between the work and its audience other than the ever present interaction of reception.

Carsten Nicolai's *Particle Noise* (2013) makes audible the background radiation of a space using two geiger counters. One of these is analogue and connects us directly to the sonified phenomenon by triggering sounds from a radio receiver. The second is digital and is used to trigger a sine wave generator, time values of the intervals between events being used to modulate the frequencies of the two resultant sine tones, as well as their panning across a four channel speaker system. It is a straightforward sonification and reads clearly as such but the sonic material follows Nicolai's compositional aesthetic, rendering the work very much his music. Again, there is no audience interaction but the process is very much available to the listener simply by inspecting the equipment in the space. This knowledge places the audience in the sonification with the realisation that these radioactive particles are acting on them too.

Perhaps the piece most similar to *Building Materials* is *Sonicity: Songs Of Atoms Time And Space* by Stanza (2010). *Sonicity* uses a network of wireless sensors to collect data, this data is fed to software which uses synthesis for sonification. Like *Particle Noise*, the data collected relates entirely to the exhibition space, a space which also contains its audience, but *Sonicity's* sensors are sufficiently sensitive to include the results of audience actions making the work interactive. The interactivity, however, is limited to a direct model. The work is shown in one room and therefore cannot describe the activity of a building as a preexistent social space, rather it sonifies the actions that it has created by its presence within a space. Further separating it from *Building Materials* is *Sonicity's* exclusive use of synthesis for its sound material. When *Building Materials* moves from venue to venue its core ingredients all change, *Sonicity*, however, retains its primary sonic characteristics, removing them from the effects of its site specificity.

So *Building Materials'* contribution is revealed by its differences from these works. The work inhabits similar fields but where they touch on one or two, *Building Materials* inhabits them all at once with a polymodal interaction model and a nuanced approach to site specificity complementing its compositional sonification. And while these territories have been touched on in this thesis, this chapter will now open up to explore in more detail their relationships with *Building Materials*.

1.5 Sound art

Looking at the literature it is possible to become bogged down in rather strident attempts at a definitive approach to sound art. Brian Kane has performed a comparison between texts by Seth Kim-Cohen and Salome Voegelin focussing on their diametrically opposed approaches to the term (Kane, 2013). Voegelin's phenomenological approach to sound art requires the primacy of the ear – the sound is all. She argues that notation (the text), in western music, is the primary work. She asserts that as we listen to music, we link it to what we know of how the text works, decoding pitch intervals and dynamic structures separate from our experience of the sound. In Voegelin's sound art the primary material of the work is just that, sound. When we attend to this, and this alone, we are engaged in an act of suspension from the signs and

conventions of western musical language. We experience the sound at no remove as it manifests as it acts directly on our ears; as the sound *is* the art, when we perceive the art we *make* the art (Kane, 2013).

Kim-Cohen's take on the matter is in direct opposition to this objectification of the sound. He maintains that sound art is everything *but* the sound. He goes so far as to advise that to best engage with Alvin Lucier's *I am sitting in a room* (1969) one should not listen to it (Kim-Cohen, 2009, p. 193). For Kim-Cohen sound art is an art of signs, of situations, of cultural texts that engage our theoretical minds rather than our experiential ears. Similarly to Voegelin he uses this construct to reject western music, arguing that sound art is made up of the material discarded by music, which music terms the extra-musical. Finding this term pejorative, he argues that 'there is no extra-music'. Kim-Cohen states that the conventions of music, by deciding that certain things lie outside them, reject the world outside of sound, and that this is the world inhabited by sound art (Kim-Cohen, 2009, p. 107).

Kane leaves these two opposing views of sound art, as well as their rejection of western music, with mention of Theodor Adorno and his insistence that we cannot separate the situation from the sounds (Kane, 2013). For Kane this seems to be what music and sound art are, the sounds and their context. Kane suggests that perhaps sound art is a label that offers a focus on individual sounds within the work but in the end he shies away from a proposition that goes further than simply addressing each work in its own right (Kane, 2013). This seems fair, allowing the term sound art to be used as a kind of guide to the audience's reception of the work rather than a set of preconditions that need to be met.

So perhaps Max Neuhaus's dismissal of the term as redundant and imprecise is rather simplistic. While it is easy to understand an opposition to the didactic proposals of Kim-Cohen and Voegelin, Neuhaus's comparison with an invented 'Steel Art' seems weak. There is certainly a place in music and art for the description of materials, if we replace the phrase 'Steel Art' with 'oil painting', or even simply 'painting', his point seems moot. He says that 'the medium is not often the message' (Kelly, 2011) but describing a work, either by giving it a title, such as calling a glass of water on a glass shelf *An Oak Tree* (Craig-Martin, 1974), or by classifying its content as Cage did with *4'33* (1952), grants the artist another layer of

conceptual expression. As a descriptor 'sound art' helps an artist, composer or curator, to direct the way in which an audience will approach a work. The label suggests a focus on the sounds as primary material and that the processes by and contexts within which these sounds are created should be apprehended as well.

If we further examine the relationship between the context and the sounds, the term 'sound art' becomes even more problematic. Many such pieces exist primarily in two forms, the situation and the documentation, and it is perhaps here that the music peels away from the art. As a homebound listener our experience of Cristina Kubisch's *Electrical Walks* (2004-onwards), for example, is very different from that of its participants. When listening to *Five Electrical Walks* the context is musical (Kubisch, 2007). We may or may not be aware of the processes that gave rise to the sounds, the CD may play in someone else's house and we receive the sound simply as music. Does this mean that what we hear is no longer sound art? Has it become 'merely' music now that Kim-Cohen's social signs and meta-texts have been stripped away? Are we listening to it incorrectly? It seems that such polarising approaches to sound art become leaden in the face of this simple physical transposition.

Schaeffer observes that sound communicates differently in different contexts, and when we, as the listener, move from one context to another our mode of listening alters also (Schaeffer, 1966). If we hear the sound of traffic works in the street the context encourages emphases towards particular modes of listening – perhaps mostly the Schaefferian ecouter – whereas if we hear it in a concert hall the context may prime us to engage the ouïr mode (Schaeffer, 1966). The audible characteristics of the sound itself will also be altered by different contexts, a hushed concert hall will deliver a road drill very different to our ears than one accompanied by the cacophony of the city. So, returning to Kubisch, it seems that when we move from the space of interaction to that of the recorded proceeds we hear the same work but with different emphasis. The phrase 'sound art' highlights the qualities which Kubisch is most interested in communicating: the raw stuff of the sound; the way in which the sound is produced; the fact that the sound is generally hidden (Kim-Cohen, 2009). But the phrase does not dictate the mode of our reception, we can hear it as composition, we can imagine urban topography, or we can view it as social commentary, any position is equally valid and the stamp of *Electrical Walks* is upon them all.

1.6 Composition

As a composition *Building Materials* has affinity with a number of branches of Twentieth Century classical music. And while it would be stultifying to list them all, it is clear that it would be remiss not to discuss its relationships with musique concrète and acousmatic sound, process music, indeterminacy and the open work. These practices and theoretical fields all loom large over much new music, from contemporary classical to dance music and hip-hop, so it feels almost inevitable to mention them but *Building Materials*' links to these practices are arrived at through slightly more oblique pathways and are sufficiently flexible to require a closer exploration.

In its use, and manipulation, of sound taken from the world around it, *Building Materials* suggests a realtime musique concrète. It harvests sounds from the world outside it, editing, transforming and re-presenting them through loudspeakers. To use Schaeffer's terms it gathers these sound events, transforming them into sound objects which it then deploys in its composition (Battier, 2007). Its use of acousmatic sound, however, is less straightforward and it is the balance between an awareness of the sound source and the apprehension of the sound it has produced that is more delicate here.

In *Audio-Vision, Sound on Screen* (1994) Michel Chion writes about the way in which acousmatic sound is in flux in film. He describes a sound becoming acousmatic from having had its sound source visible to it having moved out of frame, and how this connection, between sound and source, brings the image of its source to mind when the sound is heard acousmatically. The sound is now embodied, part of a distinct language that the film can use to communicate with (Chion, 1994). He notes that film also uses sound in the opposite way, introducing it offscreen, perhaps in order to build tension, and then revealing the source.

Sound in *Building Materials* is encountered in a way that is similar to these models but distinct from them. The sound sources are separate from the space in which they are heard but a path from this listening space can be traced back to the various sources by following the wires as they run through the building, fixed by the tape map. So the sound is always acousmatic in so far as it is heard separate from its source, but there is always the availability of knowledge of

its physical origin. The tape map directs the visitor to the root of the sound but this is always separate from the space where the speakers lie. This means that the relationship between the two states, acousmatic and visualised (which Chion suggests over Schaeffer's term 'direct') is more nuanced. The work, having given this visual information to the audience and allowed the the sound to become visualised (contrary to expectations of acousmatic music (Battier, 2007)) then undermines this perceptual link. The nature of the processed sounds obscure a definitive connection between a discovered sound source and a sound heard so their relationship becomes speculative. But it is speculative within a small, fixed, range, the sounds become *speculatively* embodied. So the sounds, while undeniably acousmatic, are produced by a discrete number of discoverable sound sources, between which the visitor can imagine links, in common with the kind of post visualised sound described by Chion (Chion, 1994).

The links between sounds produced and their sources go deeper in *Building Materials*. The sources not only provide sonic material, on which the work acts, they also make up part of the data set which it uses to create its structure. The work relies entirely on the presence of these sound and data sources, feeding into its software, for its realisation. The software itself is transportable from venue to venue, combining with my aesthetic input, arising from my intuitive response to the surrounding environment, to create the work anew. But the work is indeterminate, it will not be the same in a new venue and each venue has its own compositional stake in each realisation. Its sounds will be different, its inhabitants too, with new patterns of movement, new cycles of periodicity.

1.7 Interaction

Building Materials has a direct relationship with its audience. It is interactive and uses, to a greater or lesser extent depending on the events in the building, human action for its realisation. This relationship with the audience expands our discourse surrounding the work into areas such as interactive art, participatory art, relational aesthetics and the open work. Just how does *Building Materials* relate with its audience?

Umberto Eco's seminal essay *The Poetics of the Open Work*, published in 1959, sets out a new compositional paradigm wherein the performer of a work is granted sufficient agency within that work as to bring about an act of 'improvised creation' (Eco, 1959). The work as manuscript exists in an open form, it is incomplete until performed at which point the decisions of the performer dictate its final form. Eco cites a variety of works to support his thesis, all pieces that exist very much within the traditional setting of the concert hall. They are all quite clearly reliant upon humans for their realisation but within a very narrow context, the humans are there *in order to perform*. This is no chance encounter between the work and its realisers, the agenda is set.

Building Materials, has a more nuanced relationship with its realising agents. The catalyst for the realisation are not humans alone, but a situation with humans in it. This emphasis on a situation, rather than a discrete, contained, performance, brings to mind both Nicolas Bourriaud's *Relational Aesthetics* (2002) and Gustaf Almenberg's *Notes on Participatory Art* (2010). Both these texts attempt definitions of two distinct types of art that rely on the encounter between an art situation and its audience for its realisation. *Relational Aesthetics* focusses on works that rely on the relationship between audience and artist to the extent that the audience becomes a performer in the artists work and the artists work becomes a physical frame for the social interrelations of its audience. Claire Bishop, in her piece *Antagonism and Relational Aesthetics* points at works by Liam Gillick and Rirkrit Tiravanija as particularly representative. Gillick makes art that he describes as 'backdrop or decor' rather than content in itself while Tiravanija requires that the audience interact with him directly as he cooks in an attempt to dissolve the distinction between art institution and social space (Bishop, 2004). Almenberg's manifesto for Participatory Art is more about the moment of creation stating that Participatory Art consists of smaller elements that the spectator can reassemble as she wishes and according to her creative instincts (Almenberg, 2010). Both these areas rely on the direct acts of their human audience for the realisation of works and are explicit about this requirement.

This direct relationship with audience actions and reactions is probed by two, more technological, takes on interactive art. David Rokeby's *Very Nervous System* (*VNS*) (1986) is a work finely attuned to the actions of its realiser. An interactive sound installation, *VNS* watches

its performer and translates their actions directly into sound. *VNS* simply doesn't exist on its own, it depends entirely on the *active* input of its user for its realisation, their interactions with the work are focussed on the work. *The Source* (2004) by Greyworld is a work similarly dependent on interaction to exist but its situation is broader than the system of direct cause and effect driving *VNS*. *The Source* visualises trading data from the London Stock Exchange as a column of spheres that act as 3D pixels within the eight storey height of the stock exchange's atrium. It separates its creators, the traders on the exchange floor, from its audience, and their intentions from their visualised outcomes. They trade stocks in order to make money, not art, and in this way their interactions are *passive* towards the work. But the activity of these interactions within the work ensure that it bears their mark as it feeds off the data, visualising this interactive situation like a kind of parasite.

Returning to *Building Materials* we see an amalgam of these approaches. There are opportunities for *VNS*'s direct interaction as well as an overall framework of *The Source*'s indirect model. There are also connections with Almenberg's participatory model in addition to an indirect link with Gillick's appropriation of the language of social and office spaces. This last link is a function of the work's site specificity and would potentially be absent in other settings.

1.8 Site specificity

Site specificity is clearly a function of *Building Materials'* almost symbiotic relationship with its environmental context. The work sits embedded not just in a building's physical environment but also in its social environment. It feeds on the human and mechanical movement in the space rewarding this input with music and an abstracted, way-finding, signage. How then does the work reconcile this close coupling with the fact that it will be removed and installed elsewhere? How specific to its site is *Building Materials*?

In 1985 Robert Irwin set out a series of conditions for the relationship between an installed artwork and its setting. He proposed four rough categories for situated art that help explore the nature of a work's residence within its site: site dominant (work made independently of,

and without reference to, its site); site adjusted (a work physically adapted in consideration of a specific place, but transportable as a complete work and relocatable); site specific (a work made for a particular site but made with primary reference to the artist's oeuvre); site conditioned/determined (an artwork created as an embedded response to a site) (Stiles & Selz, 1996).

Building Materials appears to satisfy the conditions for Irwin's site conditioned/determined category. With each showing of the work a site is scoured using the microphones, pockets of sound are noted down and a map of the work is created anew. Each iteration is different from the last as a direct result of the way in which the site has been considered and explored. But there seems to be a problem. While *Building Materials* is deeply concerned with its setting it is also entirely transposable. It is not conditioned or determined by one site but by *any* site. Irwin's ultimate form of site specificity dictates that the work 'draws all of its cues (reasons for being) from its surroundings' but the reason for *Building Materials* is to interrogate its surroundings, and its surroundings are not fixed (Stiles & Selz, 1996, p. 647). The work affixes itself to any new environment, drawing its cues from it in order to generate its composition, unhooking itself and moving on. Perhaps we can use the phrase 'site embedded' to extend Irwin's list.

Site embedded is a phrase that seems to call up the immersed nature of *Building Materials* within its site, without seeming to argue that it is in some way owned by any site. Whereas site specific and site determined, as conceived by Irwin, describe work that is particular to a single site, site embedded describes the tight communion of work and site without dictating a physical particularity. It may also imply that the work is embedded within the social space of the site as well as the physical space. Bill Fontana's bridge pieces are good examples, existing as they do as attachments to the physical structure of each bridge but harvesting the sounds of the bridge's users as well as the effects of wind and other movements (Fontana, 2006). In the case of *Building Materials* the work can be seen embedded within the movements of the people within Exeter Phoenix, as they pass through and use the space, as well as within the building itself. So a site embedded work can be viewed as almost parasitic, feeding off each new site for its raw materials and dynamic content, reflecting on that site and re-presenting it transformed, or in some way new, and moving on.

1.9 Installation art

The phrase installation art typically refers to art into which the audience has to physically enter in order to experience the art. As a practice its route is generally plotted from the modernist spatial explorations of Kurt Schwitters and El Lissitzky through situations and happenings in the Fifties and on to the expansion of the practice in the Seventies and Eighties where it is usually argued installation art found its form. Since then it has risen to become the art form of choice for big art institutions with big spaces to fill. Claire Bishop's *Installation Art a Critical History* (2005) plots a course through this history while usefully expanding its historical perspective to include a more critical and theoretical discussion of the practice.

One useful point Bishop makes in relation to installation art is that the viewer becomes decentred within the work. She mentions Erwin Panofsky's thesis that renaissance painting used its rigid perspective to place the viewer at the centre of its world. Installation art by its immersive nature, and its usual allowal of many more than one viewer at a time, disrupts this hierarchy to remake the relationship between object/art and subject/viewer as a more dynamic and fluid system (Bishop, 2005). This fudges the boundaries between object and subject as viewers become active within the work themselves, even without the work being explicitly interactive. Examining *Building Materials* through this new lens we find differing foci with respect to architectural and social space.

Like *Building Materials*, *Music on a Long Thin Wire* has a direct relationship with the space in which it is situated. The most clear example of this is the length of wire allowed by the space but the way in which the wire cuts through the space acts as an architectural intervention in itself, bisecting its surroundings and curtailing audience traffic. But more pertinently when we consider Bishop's decentring, it is useful to keep in mind that the primary material experienced by Lucier's audience is sound, the diffuse and permeating nature of which renders Panofsky's centred viewer even less likely.

Installation art is also concerned with space. With Lucier's piece the installation space is active within the work, events within its setting resulting in harmonic changes to the sounding of the wire (Cox, 2004), in addition the wire slices through the space reconfiguring its pathways (Lely

& Saunders, 2012). In other works we can see a different approach to space, there is a kind of appropriation of architectural space as another material within the work. Neuhaus's diagram for *Drive In Music* shows very clearly a territorial grab of sections of the Lincoln Parkway to become his work (figure 1). The street is not changed visually in any way but with the right equipment each section of the road becomes musical material in his larger construct, the space delineated by broadcast sound. *Building Materials* performs a similar appropriation of space. The physical and sonic environment of the building is repurposed as material for the work, unseen volumes are made distinct by the influence they exert over the composition. In a sense nothing is installed here other than a new awareness of these volumes in the work's audience. But, similar to other installations, once the exhibition is over the sensors and microphones are removed and these particular volumes cease to be active in the work.

[Image redacted in this digitized version due to potential copyright issues]

Figure 1: Diagram for *Drive In Music* (Neuhaus, 1967)

This last point is salient to all installations: they are temporary. This ephemerality is a function of their status as transformative environments, or situations within pre-existent spaces, rather than as objects (Bishop, 2005). These works engage with the space in which they are installed in a variety of ways and when they are removed and reinstalled somewhere else they will engage with this new space differently, with different results. Each new iteration of the installation will flavour the work with its new context. This is very much the case with *Building Materials*. The work feeds off its environment, using the flow of people, air, light, sound and electricity through architecture, to provide the raw materials with which it composes itself.

When installed in a new environment it will be given a new set of these ingredients which which to make itself and which will then be reflected in the resultant music.

Chapter 2

Methodologies

2.1 Introduction

This chapter introduces the ways in which this research project is articulated as well as the key processes driving *Building Materials*. The first section sets out the methods used in the research discussing the questions arising and how they are addressed, as well as describing the research model within the broader context of practice-based research and how this is applied within this research. There follows a section outlining the broader methodologies at play in the creation of *Building Materials*, including possible alternatives to the routes taken by the realisation at Exeter Phoenix. These methodologies arise from the research problems outlined in section 1.2. This is followed by a section discussing sonification, its origins as a method for parsing large data sets and its co-option by the arts. Its examination uncovers the question of what, and how, does a work communicate as a sonification. This leads into a section on mapping which expands on this question by interrogating the cultural status and inherent tensions of mapping as a process. The chapter ends with a section unpacking the subtle use of the word 'story' in this thesis.

2.2 Research methods

This practice based research reflects upon the tacit knowledge gained through the creation of the installed composition *Building Materials* in order to draw out a procedural knowledge that can be employed by others. The research problems, as set out in section 1.2, arise from the act of making a piece of music from a building and are given focus by my intuitive responses to this problem. As such the principal method underpinning this research project is the making of the work. This method is unpacked into discrete processes which are presented as an open plan for any similar work. This thesis then interrogates the work, building upon its unique contributions to uncover new ones, and places it within a broader cultural context. This enables a detailed discussion around the fields and methods at play within the research and finds new ways to articulate their interrelations.

The model of research most closely followed in this project is that of arts-based research as set out in *The SAGE Encyclopedia of Qualitative Research Methods* (Given, 2008). Here Tom Barone

outlines a practice that acknowledges the differences between research in the arts and research in social sciences, pointing out that the 'strive towards a high degree of certainty' (2008, p. 30) that typifies research in the social sciences is at odds with the aims of the art-based researcher. Instead art-based research may result in discussion of different possible readings of a work and how it reflects on the world around them. It achieves this through the 'reorganization of aesthetic content ("data") into a form that will entice the reader into a textual engagement' (2008, p. 31) with the phenomena under investigation. This is an attempt to coax a 'rethinking [of] the conventionally "real" world' (2008, p. 31), a reappraisal of situations that have either become accepted or may be simply overlooked. To simplify, successful arts-based research will result in work that prompts an audience to re-examine their surroundings, casting them in a new light, either explicit or implicit.

As a result arts-based research delivers no concrete findings as such (Borgdorff, 2011). Instead my research offers a contribution to the knowledge in the form of a large scale work of music/ installation art. The work is made using techniques which position it in very fertile territory for discussion, between music, art, sonification and interactivity. Furthermore, this thesis contributes a way in which an artist can signal a particular kind of work – 'installed composition' – and a process by which an audience can parse this work as a storytelling situation – 'reverse mapping'. There is also the tacit knowledge gained through practice, which is distilled into procedural knowledge, and the tacit knowledge gained by the audience in the installation, which is unpacked by exploring the tacit knowledge that I gained.

2.3 Methodologies towards *Building Materials*

The problems outlined in section 1.2 relate to both the practical issues involved in making *Building Materials* the installation, and also to the aesthetic problems of generating *Building Materials* the composition, from the material of the Exeter Phoenix. These problems are addressed by a number of processes which I will set out broadly in this section. These processes combine to become a method for the interrogation of any building or space in which *Building Materials* is to be installed. They also add up to a model for an installed

composition that attempts to engender a coherent reception of the work, its process and aesthetic, through signalling that process within the work itself. This signalling is not an additional contextual add-on but is embedded within the work's methodology. The process of making *Building Materials* will be discussed further in the thesis with particular reference to this particular iteration of the work in chapter three, and with reference to the aesthetics of the work in chapter four. Here I will set them out as a series of steps through which a similar work could be made.

The first problem, that of choosing the sounds that make up the core of the work, can be addressed by the undertaking of a sound walk. Hildegard Westerkamp describes a sound walk as being any exploratory walk where the 'main purpose is listening to the environment' (Westerkamp, 1974). A sound walk will often include the use of microphones and headphones as a simple means to focus listening, blindfolds are also often used to similar ends (McCartney, 2014). In order to answer the first research problem fully this sound walk needs to look for sounds which can drive the composition both aesthetically and practically. This means that the sounds need to function both as audio material and as a data set that can be mined for information about the activity within the building. Analysing the chosen sounds for amplitude levels and volume spikes provides a solution to the second problem. Interpreting this data reveals information concerning thresholds, user densities and discrete activities within the building.

A further method of harvesting data from the building is the use of sensors, in the case of this iteration of *Building Materials* movement, light and heat sensors. These provide a broad range of areas of influence. For *Building Materials*, the light sensor was used to follow day and night cycles but it could just as easily be used to detect shadows, as in the work of Peter Vogel. Movement can be detected through the analysis of a video feed. The cv.jit package of externals, by Jean-Marc Pelletier, contains a number of objects that can provide detailed image analysis in Max (Pelletier, 2004). For this project, however, computer resources were not plentiful and the provided machine was not powerful enough to run the image analysis alongside the sound engine. Future iterations may explore the use of image analysis for a more nuanced reading of people's movement. The movement sensor that I chose had quite a narrow focus in order to obtain information about a very specific part of the building, but

there are many that work more broadly. The heat sensor was used very broadly in *Building Materials* at Exeter Phoenix, conflating increased heat in the bar are with an overall increase of visitor activity within the building but again it could be used differently in a much more focussed way. Attaching it to the heating system, for example, could provide a way into the composition for another of the building's systems.

The third question links with the first but concentrates on a building as a social and physical environment, rather than a sounding space. The space is interrogated for its patterns of use, within both the actions of its users and the systems which allow the building to function. There is a lot of information available and it is possible to conceive of an iteration of the work which concentrates solely on particular functional subsets within either of these two main areas. Versions which focussed purely on communications or water systems for example, would be very different and potentially just as rich. When looking at patterns of use it can be useful look for ways to translate them into musical function. Corridors can be viewed as rests between actions, they can also reveal user densities as larger groups flow through them, creating swells. Points of high but discrete activity, such as the lift, can be useful as instigators of regular dynamic change.

This consideration of action points within the site leads us to the fourth problem, the balance of modes of interaction and their relationships to the sonification. This demands an awareness of the nature of the interaction points, will they be active *and* passive as a threshold trigger will be, or simply passive, as a temperature sensor would be? The problem is also addressed by making sure that the modes of interaction are distinct within the work, and that cause is separate from effect. This last point is crucial for making sure that the work does not sonify itself.

The model for interaction needs to be apparent within the work as the reception of the work as a sonification depends on it. There are many ways of approaching this problem, a realtime, onscreen, visualisation could be programmed, linked closely to the sonification data. Cameras could capture the moments of interaction and display them in a hub space. Or, if a more dynamic audience engagement with the building is to be fostered, a more physical solution

could be pursued, mapping the work for visitors, in order to help them explore their relationship with the work.

The final problem concerns the fact that the raw sonic material of a building has its own character and aesthetic. A decision needs to be made as to what extent the work is the building and to what extent will the material bend to aesthetic impulses. A balance between sound from the building and processed sound, and events from the building and designed events that were triggered by the building, has to be struck. In order to do this some form of maquette needs to be made in order to test solutions and balances in approximation until the work is installed and fine tuning can be carried out. This then provides a model of the situation with which to build the software. The act of programming, in this case, becoming the main component of compositional input.

2.4 Sonification

At the core of *Building Materials,* the methodology most explicitly driving the work, is sonification. The practice of communicating non audio data through sound has been dated by the sonification community[1] back as far as 1878 (Hermann et al., 2011, p. 304) and sonification as a concept was established in the 1980s, these developments being further consolidated at the first International Conference for Auditory Display (ICAD) in 1992[2]. Volker Straebel expands this further, quoting Thoreau's *Walden* and referencing the Aeolian harp (Straebel, 2010). So there seems to be a sense in which sonification, as theory, is only just catching up with the practice it describes. The definition which seems to still persist runs 'Sonification is defined as *the use of nonspeech audio to convey information*.' It continues, 'more specifically, *sonification is the transformation of data relations into perceived relations in an acoustic signal for the purposes of facilitating communication or interpretation*' (Kramer et al., 1997, p. 3). Looking at such a broad definition as the first it seems that the lens of sonification is a useful one through

[1] By this I refer to a group of writers and researchers regularly contributing to ICAD conferences, many of whom have work published in *The Sonification Handbook.*

[2] This conference seems to be a kind of year zero for the sonification community, with the section in *The Sonification Handbook* containing the reference above being titled "12.2 Brief Historical Overview (before ICAD, 1800-1991)"

which to examine not just *Building Materials*, with its digitised data set and computer modelling, but also works by Lucier and Neuhaus, Fontana and John Luther Adams as well as many other examples of process music and the open work.

Recent works in this field demonstrate differing levels of readability, with pieces ranging from the easily decoded to the distinctly occluded. A clear picture of the sonified phenomenon can be gleaned from Nicolai's *Particle Noise*. Within the work Nicolai makes clear the link between the phenomenon and the sound world with the use of his familiar austere aesthetic. There is space within his very particular sound world to identify the discrete events driving the work.

Nicolai's use of single discrete events in *Particle Noise* is in contrast to Andrea Polli's *Atmospherics/Weather Works* in which she sonifies storm data, the complexity of which results in a rich sound world which in some ways presents a barrier to parsing the data set. Similarly Adams uses the sonification of large scale phenomena in *The Place Where You Go To Listen*. However, in contrast to Polli, Adams' focus here is musical. He has chosen to generate sounds that are in some way mimetic of the phenomena that generate them, but the relationships between these sounds have been set out with a focus on their compositional functions (Adams & Ross, 2009). Their names evoke the origins of the numbers driving them with his 'earth drums' reacting to seismic data and the 'aurora bells' responding to geomagnetic events in the upper atmosphere, but their compositional coherence reveals Adams view that these phenomena constitute a 'music just beyond the reach of our ears' (Ross, 2008). These pieces also recall the work of Charles Dodge, whose *Earth's Magnetic Field* (1970) stands as one of the earliest examples of sonification as composition.

As I mention above, the term sonification speaks to many works that were created before the term's inception. *Drive in Music*, for example, acts as a sonification of a number of interacting phenomena. Traffic, weather, pedestrians and the intuitive reactions of the audience as they drive through the composition all act together to create a piece of music that sonifies its surroundings. The sonification is not a literal one in any way, were the results to be recorded and heard afterwards it is doubtful that any true understanding of their context would arise, but it is a sonification nonetheless. Data from the surrounding environment is collected by means of car speed and direction and radio interference to influence the form of the

composition. In addition Liz Kotz quotes Neuhaus as saying that 'in the prototype version, the sound generators themselves were weather sensitive, i.e. they were composed with electronic circuitry which was sensitive to changes in temperature, humidity, and light, so that the sounds themselves were constantly changing with minute changes in the atmospheric environment' (2010, p. 100). So Neuhaus created an ecosystem sonifying traffic and radio wave propagation, sensitive to weather and the surrounding cityscape and making music embedded with the narrative of its context. *Drive in Music* is not explicit in its sonification, it is primarily a piece of art, but the information is there, a function of the system. However in all these instances, with the possible exception of *Particle Noise*, we hear a jumble of inputs mapped onto a single output, rendering it nearly impossible to know where movement within the sounds originates. We don't really know precisely what we are listening to.

This being the case how can we parse these works? We can listen to them purely as sound, trying to apprehend their meaning through Voegelin's phenomenological approach, but maybe this leaves us impoverished (2010). While Kim-Cohen may overreach with his outright dismissal of sound he is helpful in highlighting the importance of context (2009). So with an awareness of context, a knowledge of the processes behind these works, how does the addition of sonification to the discussion of their methodologies expand understanding of the works? To my mind their processes, our awareness of these processes, and an imagined reverse mapping of these processes, can prompt an audience to imagine stories about their sonified phenomena. These stories are not accurate from second to second but the overall structure of what we hear combines with our knowledge to give us the flavour of what is sonified, a kind of trace[3].

[3] The word 'trace' is used deliberately in reference to Susan Sontag's *On Photography*, in which she describes the photograph as being 'a trace, something directly stencilled off the real, like a footprint or a death mask' (1977, p. 120). The correlations between photography and sonification – the direct relationship between subject and art object, the apparently impassive objectivity undermined by the subjective acts of framing, editing, mapping – seem fruitful for further research, but too sprawling to be included here.

2.5 Mapping

Mapping, both as process and as aesthetic, is a key component in the way in which *Building Materials* communicates. It is clearly a theme when confronted with the rivers of tape scribing their way across the walls. And it is at the heart of sonification, the main methodology driving the realisation the work. The following section interrogates *Building Materials*' relationship with the map as an object and, most pertinently, with mapping as a process, in order to explore the way in which mapping helps disseminate the narratives inherent within the work.

When discussing mapping in relation to *Building Materials*, the focus is not solely the appearance of the work. The similarity to a map is certainly there, and deliberate, but this link helps to underline that the tape map, as well as its aesthetic function, works as a tool to communicate the process. So when discussing mapping I am primarily concerned with the means by which the piece, as an audible composition, knits itself into its host building; the direct translation of action to sound. This is achieved through technology. Using sensors and sound the composition can react to actions and phenomena within its environment in real time, mapping the data processes within the software to produce audible outcomes. Mapping is the process behind the sounds and the tape map draws attention to this, visually declaring the process and reinforcing its links to the map as a cultural object.

Traditionally maps are used as tools. They give us the information we need to navigate cities, regions, countries. In order to do this with any success they depend on our trust, we need to be able to believe that what they show us on paper, or screen, correlates to the physical world around us. On a UK map the symbol of a cross denotes a church; we know that if we go to the place represented by the cross we will not find a train station. This seemingly trivial observation is key to the power of the map. The map projects a veneer of trustworthiness, of truth, indeed it relies on this projection to be of any worth, if we travel to the point marked by the cross and *do* find a train station, or if it sends us down roads that do not exist, to fictional towns by fictional rivers, then the map becomes simply a piece of paper with drawings on it (Wood, 1993). A map need to be accepted as truthful in order to be useful as a map (Denil, 2003).

The assumption of objectivity is where maps get their power but on closer inspection this assumption seems spurious (Denil, 2003). Maps have the power to persuade and this power can be used to advance propagandistic positions. This may be in the form of redrawing the boundaries of countries in a territorial land grab or simply highlighting areas of interest in a national park (Wood & Fels, 1986). These maps are not objective, they have emphases and intent, they aim to alter the way people think about the area they represent. Mark Denil describes the map as a rhetorical entity, noting that 'a map seeks in some manner to convince someone of something' (Denil, 2003). Essentially maps tell stories, and the stories they tell convince because of their semiotic role in culture (Denil, 2003, p. 26). Denis Wood and John Fels lean on Roland Barthes' system of language and myth to recast the map as myth (Wood & Fels, 1986, p. 62). But Wood and Fels also note that maps, with their appearance of truth, do not declare themselves as myth and there is a resultant confusion where, as Barthes says, the signification (in this case the map) is cast as fact 'whereas it is but a semiological system' (cited in Wood & Fels, 1986, p. 63).

Using myth as a semiotic system to discuss *Building Materials* throws up some interesting questions about sonification. As an artistic practice sonification tends to present itself as somehow revealing a hidden aspect of the sonified phenomenon. Andrea Polli casts her *Atmospherics/Weather Works* project, a series of sonifications of storm data, as the hidden narrative or experiential dimension contained within the weather data sets. She aligns their contribution to the understanding of the data set with the heightened experiential understanding of tornados that storm chasers gain from their dangerously close proximity to the phenomena (Polli, 2004). But as Alfred Korzybski's famous dictum states, 'A map is not the territory' (Korzybski, 1933, p. 750). The sonification is not the phenomenon. *Atmospherics/ Weather Works* is *not* the storm, it is Polli's response to a data set and any narrative or experiential dimension it adds to our understanding of the data set is enormously coloured by the act of her subjective translation. None of this diminishes Polli's work but it serves to highlight the semiotic confusion surrounding maps and, by extension, sonification. Polli uses storm data to tell stories of them in sound. When we listen to them we do not hear the storm, we hear Polli's music, but an awareness of her process allows us to imagine the storm. We lean on our trust of the map as being an analog to the phenomenon in order to translate sound to

imagined meteorology. Sonification is the semiological system that grants us confidence in this response.

Maps as stimuli for the imagination are nothing new. In his paper *Pleasure in the idea/The atlas as narrative form*, Wood eulogises the use of maps and atlases as a kind of visual storytelling (Wood, 1987). We can lose ourselves in coastlines, imagining beaches, rock pools, rolling down imaginary sand dunes. Maps are used in fiction, lending weight to the idea that an imaginary landscape exists. When signalled as fictional the map is not undermined but instead adds its cultural authority as a trustworthy, truthful, document to reinforce the fiction. Mark Denil highlights the physical form of the map too, the act of the unfolding, spreading out on a surface, a being part of the enjoyment of maps (Denil, 2003). *Building Materials* of course has none of this immediate narrative pleasure as the tape map is not a map of Exeter Phoenix, it is a map of part of a process, a sign that data from particular events are being collected and being used in particular ways. Also, rather than the size of a book, or the spread of a table, the scale of the tape map is 1:1, its uselessness for remote navigation and reflection recalling Borges's *On Exactitude in Science* (Borges & Di Giovanni, 1972), instead the map functions as a guide to the Phoenix, leading one through its corridors, highlighting points of sonic interest[4]. It draws a map of the building in the mind, where it is kept and referred to while listening to the composition. But the tape map remains distinct from the act of mapping, the sonification that takes place within *Building Materials*. The tape map does not map the Exeter Phoenix, the composition, with my subjective response directing it, does.

2.6 Storytelling

This thesis proposes a subtle link between the act of parsing a sonification and the act of apprehending a story. In *Building Materials,* stories are made piecemeal, multiple viewpoints on multiple events accruing bit by bit to make a whole impression of the situation creating the work. Mieke Bal presents a useful model for narratology that can be used to explore the narrative of *Building Materials* and its dissemination (Bal, 1997).

[4] Indeed the information desk used the tape map to help visitors navigate the building quite apart from the artwork in a similar fashion to the walkway signage leading pedestrians to and from London's Barbican Centre.

Bal's model of narratology can be broadly summarised as follows. The *fabula* is the wider situation and the events within that situation as imagined by the author. It is communicated through the *story*, a sequentialising of the events of the fabula that is given direction by the writer's *focalization*; the viewpoint that the author brings to bear when organising the story. The story is disseminated through the *text*; the medium through which the story is communicated. Bal's text can exist in many forms and is not limited to written words (Bal, 1997).

In order to clarify the use of the term 'story' within this thesis it would be useful to set out the fabula communicated within the work. The fabula of *Building Materials* is the combination of three key elements. The first of these is the imagined cause creating the effect of the music: this is the direct mapping of specific action to sound as outlined in section 2.5. The second is the wider construct within which these actions take place. In this case this is the Exeter Phoenix, viewed both as a physical, architectural space with its own specific sonic material, and as a social space containing a multiplicity of activities and situations. The third element is the general activity of the people within this construct, among which are the discrete actions that generate sound events.

So how is this fabula disseminated? The listener in *Building Materials*, having been exposed to the process behind the work by the tape map, can listen to the composition with an awareness of the sources of both the sounds and the actions creating change in the work. The sounds heard are the results of actions both audible and inaudible but sonified. Listener speculation can assign a source to these sounds. These sounds and speculations accrue to create a whole impression of the broader setting that contains them. This impression then comes to life as a story of a situation imagined in response to the composition and its process.

Returning to Bal's model of narrative we can see that the fabula is the entirety of the Exeter Phoenix, its sounds and the events within it. The text of the story is the music, by which the fabula is delivered to the audience. The story is constructed in the minds of the audience, different for each one given their own particular viewpoints and filters, their focalization. But here we find nuance. Usually the fabula is the imagined situation that is given order by the story and disseminated in the text, here the fabula is fact, the actions and sounds are occurring

at the moment their text is apprehended. The story, then, is the informed imagining and ordering of the fabula – the Exeter Phoenix – in the minds of the audience.

Chapter 3

Building Materials

3.1 Introduction

This chapter deals with *Building Materials* as a piece of work. It documents the practical process of making the work, discussing the tacit knowledge arising from this process. It begins by describing the process of choosing and manipulating sounds, going on to discuss the way in which dynamic form was coaxed from the building and its sounds. It then sets out the processes within the software I wrote through which the audio passes. After this the chapter describes the physical process of making the tape map before ending with a section reflecting on the way in which my professional practice helped develop an interest in sonification and interaction, which in the end lead to *Building Materials*.

3.2 Material

As was set out in section 2.3, my first contact with Exeter Phoenix was a sound walk which was made in order to explore the sonic environment of the building. Using a contact microphone and a digital recorder I undertook a survey of the nooks and crannies of the space, aiming to uncover potential sound sources. The process of choosing these sources was a musical one, I looked for dynamic, textural and harmonic content and a capacity for revealing event patterns within the building, sounds with both aesthetic and structural potential. Certain areas held promise due to the dynamic activities they hosted – the sprung floor in the dance studio – other areas gave up the sounds of background processes within the Phoenix – the ice machine in the cellar. The final sound choice was a useful one in terms of audience engagement. Outside the lift on the first floor of the building rested a broken piano. It sat by the path between the lift and the drama studio, a room that hosted, among other things, a variety of parent and baby singing sessions. This meant that the piano received lots of attention from the younger users resulting in some of the more strident interventions into the piece and giving an indication of when these kind of events were taking place.

This last point was a consideration when choosing sound sources as data for sonification and helpfully engaged with the first of my research problems. It became clear early on that as well as providing the raw sonic material for the work, the contact microphones could also act as activity sensors. This could help focus on areas of incident within the building, reinforcing the

relationship between composition and context. Movement within Exeter Phoenix was episodic rather than constant, people would pour through the doors for particular events, increasing user, and therefore interaction, density within the composition. This increase in activity was mapped so that the software would concentrate on the three loudest sound sources. My aim was for the composition to feel as if it were casting its eye over the building and stopping to listen to areas of particular interest. During busier times *Building Materials* could become quite peripatetic, its attention hopping from space to space. In quieter moments its gaze might settle upon the background processes within the Phoenix and the composition would calm, becoming more contemplative, less skittish.

The third research problem, that of where the work would interface with the building, was also part of this process of placement. In addition to their audio content, the sound sources provided information concerning modes of interaction in a variety of spaces around Exeter Phoenix. The microphone on the lift gave data about activities that needed assistance getting up the stairs, baby groups used the drama studio on the first floor, filling the lift with buggies. The dance studio hosted drumming workshops, another lift centric activity due to the size of the drums. This activity was reinforced by the microphone on the sprung floor of the dance studio itself, which also picked up on ballet classes, Zumba fitness and so on. This awareness of the patterns of the Phoenix's activities could lead to a situation where on a Tuesday at 2pm, for example, there might be some commonality with its state at the same time the previous Tuesday. This was no more than additional texture, certainly not an outcome that I needed to explicitly reveal.

The microphones gave a picture of the overall activity within selected parts of the Phoenix, this information was augmented with three non audio sensors. An infra red motion detector was used to monitor the activity in the entrance foyer. This space became crowded during larger events in the building and was therefore a useful measure of just how active the building was, during quieter periods this sensor would provide sporadic punctuation as people entered and exited. In addition there was a temperature sensor in the bar area. This, I hoped, would give a sense of how many people were in the main social space within the Phoenix as body heat would increase the temperature in the bar at busier times. The sensor would use this, more linear, information in subtler ways within the work. The final sensor was a light sensor,

looking through the window from the gallery space/listening room, bringing the passage of day and night into the work.

Having decided upon the sound sources a series of lengthy recordings was made from each in order to mock up a rough software version of the Exeter Phoenix within Max. Using this model I could begin investigating how the final piece might sound. I started by simply listening closely to the material I had recorded. I wanted to allow each sound to fully inform the ways in which they might be processed and although technical limitations, principally processing power, precluded individual effects banks for each audio source, I wanted to ensure that the processes I did choose would be flexible enough to allow each sound to speak in its own voice rather than simply that of the effect itself. So concentrated listening helped me choose the series of processes that would highlight individual characteristics of each sound, as well as being distinct in themselves and satisfying my aesthetic impulses.

I decided upon three basic categories to explore within each sound, harmonic, rhythmic and textural. These focussed my choice of processes, helping them become investigatory tools rather than simply impositions of particular sonic characteristics. The first I considered was harmonic. I was keen to have some sort of pitched voice to give the work the widest range of sonic material with which to sound. The vocabulary and structure should come from its surroundings, Exeter Phoenix, but I wanted *Building Materials* to communicate stories of its own making, and I felt that pitched content should be part of the language it could use.

Given that the sounds collected were principally textural, how then could this harmonic content be produced? The processing needed to have a lightness of touch in order that the imprint of the original sounds remained. Certain processes were too transformative, using resonant delays and comb filtering created lovely tones but glossed over detail in the sounds and I wanted this stage to be a more delicate one. Using bandpass filters worked up to a point but the harmonic character seemed linked more to resonance than any focus on particular frequencies. These felt like blunt tools so I started looking at spectral equalisation and filtering, settling on John Gibson's jg.specteq~ external for Max (Gibson, 2009). With this more precise tool I began creating preset groups of partials, looking for combinations of resonating frequencies within each sound. Some took to this process more than others, the rubbery door

seal had a very clear set of frequencies to focus on. Others, such as the geiger counter/buzzer were more fragile and I used this effect very sparingly on them. In this way I could create pitched material with a strong link to the source sound.

Rhythmic content was a challenge as well. I did not feel a need to include any complex rhythmic structures, simply a sense of a temporal grid against which other discrete events in the composition could be offset. I wanted the chance for a transient predictability, a fleeting knowable form that would grant moments that were easily decodable among the flow of unpredictable textures and dynamics. Rhythm asserts itself through the repetition of a 'sequential pattern of durations' (Honing, 2002, p.227) so my problem was the imposition of repetition, of time dependant structures, upon a realtime environment where repetition was very unlikely. I was unwilling to let the music become uncoupled from its real time links to Exeter Phoenix as I felt this would have the potential to dilute the confidence in the process that I was trying to engender, so obvious solutions like looping moments of buffered sound were undesirable. So I decided to impose a rhythmic structure onto the stream of sound using volume envelopes. Percussive envelopes were looped to make pulsing form from whatever source was acted upon, some short, quickly fluttering, some longer, chime like envelopes, repeating and diminishing over time. This stamped a repetitive dynamic structure on the output, the grid like nature of which could help to anchor the more chaotic textures and timings.

Textural content was far more straightforward to gather but in the interests of the long term development of the piece I felt I needed more than the eight options the building gave me. I looked for processes that could generate material from the sounds I fed them but that could, again, be sensitive to the sources. The spectral filtering that I had used to search for pitched content was also useful for picking out frequency grouping that, while obviously *of* the original sound, were also usefully different modulations. I also looked at granular synthesis as a possible process. I used Nathan Wolek's gran.chord.live~ patch as it treats incoming streams of audio rather than using existent sound files, as is more usual with granular synthesis. Using his patch I made a number of presets that I could apply to each particular sound should the composition choose to use them. This small suite of operations expanded the textural scope of

the work and again reinforced the aesthetic that made up my response to the sound from the space.

3.3 Form

Addressing the problem of where the work would make contact with the building also involved the challenge of trying to organise a kind of musical form. Having explored possibilities for pitched content within the work, it seemed that this pitched material could not be the focus of *Building Materials* as the processes involved felt too transformative to be used frequently. Texture seemed to be the building's principal mode for acoustic communication and the textures that had been found contained a wealth of dynamic variety, it therefore felt natural that dynamics should become the key means to bring drama and formal development to the music. The challenge was to sift through the data available, be it audio or sensor data, and find space and density, silence and noise, crescendo and diminuendo, bursts of intervention and the gradual temporal development of the building's perpetual activity.

Thresholds were an obvious starting point, a potential binary switch of instant change. Threshold events were detected mainly through audio analysis, doors had buzzers or motorised mechanisms, lifts clanked, but the front door had a motion detector that was set up to determine four levels of user activity at the threshold. This activity scale would allow the piece to respond to larger public events within the building, which often involved members of the audience gathering in the entrance foyer. So as motion there increased the composition could become more skittish, jumping between processes and volume envelopes.

If threshold activity tended towards the staccato, a small or large scale change in the composition, then the accumulation of these events could become a steadily increasing integer of influence. Accumulating a running total of discrete acts in the building gave an upward ramp that could modulate over a longer timescale and, given a target, then reset to zero with another more profound change. Another more gradual stream of modulating data came from the heat sensor in the bar. The small changes in ambient temperature in the bar were routed to more subtle controls within the work such as filters, relative volume levels and envelope

maximums. These allowed the temperature to affect the overall work, higher values making it more dynamic and spectrally brighter, but its impact on the immediate sound environment was less pronounced.

The principal sources of dynamics were the sounds themselves as they were harvested from the space as decisions on which sounds to use had been made with dynamic content in mind. An example was one of the threshold microphones. Attached to a buzzer on one of the less commonly used doors this had a forceful impact when the buzzer sounded but its dormant state was equally important. One of the things I was consciously looking for was rhythmic material and during my audio investigations of the building at the start of the project I discovered that this particular buzzer gave off, when not buzzing, a gentle ticking akin to a Geiger counter. So the buzzer provided an occasional background of rhythmic texture, interrupted by buzzer bursts of rough pulse wave. Similarly the ice machine, tucked away in the beer cellar, the one tape line that led to a tantalisingly non public space, provided a steady texture of dripping water. Every few hours however it would deposit its latest load of ice cubes into a lower part of the machine, suddenly jumping to the fore in the composition and asserting itself over the other sounds with a percussive intervention.

3.4 Software

The palette of sounds having been gathered and augmented and Exeter Phoenix having been approximated in software, the next few months were spent gradually building the piece in Max. It seemed natural that the composition should grow as a response to the timings and sounds gathered from its setting so a bottom up, iterative model was used for designing the piece. I started making small modules that could be nested within larger ones that would make up the patch, the top level patch being a simple interface allow adjustment after installation. This iterative process moved through a number of stages, beginning very simply and increasing in complexity until it finally arrived at the signal path shown below. The process driving this iterative stage was my intuitive response to each additional layer that the new programming added. The patch would expand, I would listen, react and then either keep or

discard changes that had been applied until I was confident that the final result was sufficiently robust, both in terms of the integrity of its programming, and in terms of its compositional aesthetic. It was a reflective process, aligned with my compositional methodology, that gradually steered the work towards my aesthetic goals.

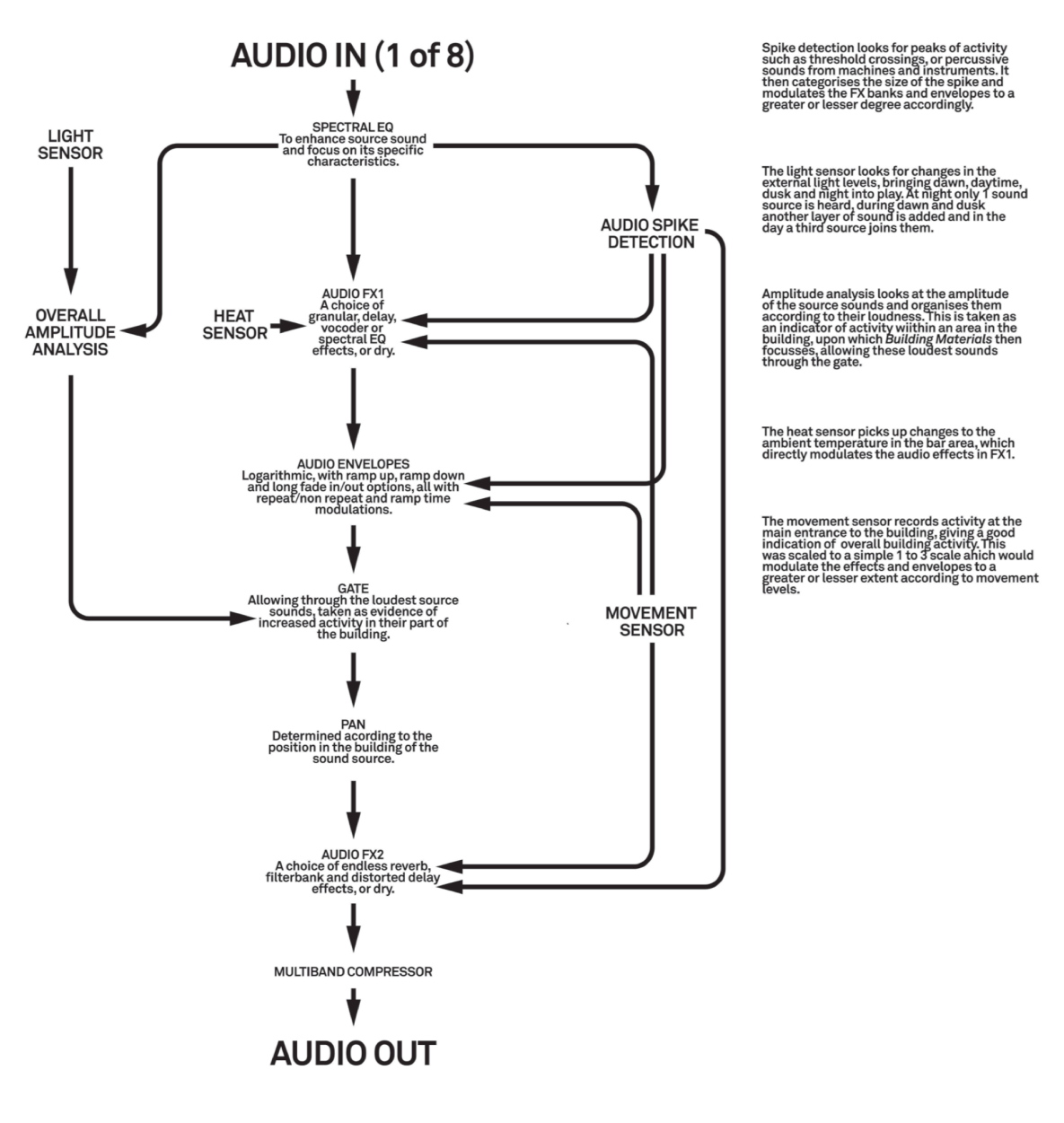

Figure 2: Diagram showing the signal flow between a microphone input and the loudspeaker output.

Figure 2 shows the final path of a channel of audio coming from one of the eight contact microphones fixed throughout the building. Audio entered the computer via an eight channel audio interface and was first treated by the spectral equaliser. This equalisation stage was used to focus on the frequencies which were particularly characteristic of what a microphone was attached to, an example would be the back door which produced a rubbery scraping sound when opened. As the contact microphone was attached to the glass of the door it also picked up ambient sound from the car park outside so equalisation was used to diminish this and focus more on the sound of the rubber. Due to the paths of the microphone wires power hum was also an issue and while I was eager to retain some of this, for reasons that I will discuss later, equalisation was also used to prevent the hum from overpowering the signals from the microphones.

After the initial equalisation stage the signal split off in different directions, being analysed by two different processes and also passing directly through a first bank of audio effects. The first analysis simply looked at the amplitude of the signal from the microphone in order to gauge the level of activity in that particular zone of the building. The inputs were then ordered, with the signals with the highest amplitudes being heard by the audience in the hub, the precise number heard being decided by the external light levels. The second analysis used Miller Puckette's bonk~ object to look for amplitude spikes in the signal, these were then used to trigger changes to the effects and the audio envelopes. The third path, at this stage, took the audio signal through the first bank of effects where interactions from the rest of the building chose what process would act on the sound, if any at all as there was also the chance that no effect would be applied, thereby preserving the original sound.

The next stage shaped the resulting sound with an audio envelope, various configurations of which were possible, again chosen by activity in the building picked up by both the amplitude spike analysis and the movement sensor. A gate then let the number of sounds through appropriate to the external light levels, during daylight there would be three, dawn and dusk would allow two through and the night would limit the number of audio sources completing the journey to the listening hub to one. The sounds let through the gate were then panned according to their positions in the building and passed through a second layer of effects, this time more textural in character. An endless reverb helped prevent the work from being a series

of staccato jumps by allowing the imprint of previous events and sounds to bleed forward in time, merging with the current output. A modulating filter bank added a further sense of motion to the signal and a distorted, and very short, delay added a textural spikiness. Again, the choice of which of these effects would be acting on the sound source was determined by events throughout the building, with a fourth option to leave the signal unaffected. The last stage before output to the amplifier and speakers was a multi-band compressor, applied lightly, which helped stabilise the dynamics, and reduce the impact of any very high or very low frequencies.

3.5 Installation

The visual component of *Building Materials* consists of enough coloured tape to affix necessary wires to walls ceilings and doors, as dictated by the physical form of the building in which it is housed. In the case of the Exeter Phoenix installation, each microphone and sensor was attached to the computer using a total of about six hundred metres of cable. Fifty millimetre wide electrical tape in a variety of bright colours was used to secure the wire and to act as a stylised visual signage for the work. In this way the mechanics of the piece were made visual, drawing a viewer into the work by laying out the process for them to inhabit. It promoted audience interaction too, offering paths for exploration and points of contact, whilst also delineating the limits of those interactions and clarifying the audience's relationship with the work.

Building Materials at the Phoenix had been given a generous two weeks to set up, it was finished on the afternoon before the opening, the principal reason for this was the tape map. I had conducted limited tests of the tape at home, practicing the 45 and 90 degree turns that it would make as it passed across the walls and ceilings of the Phoenix. These tests were conducted on flat walls devoid of pipes and architrave, they went through no doors and encountered no emergency exit signs. They did little to prepare me for the actual undertaking in situ. The issue was not with the tape but with the wires that were being fixed to the walls which lacked the flexibility of the tape and struggled to round corners with elegance. After a

few tests on site it seemed that the best way to overcome this problem was to be fairly rough with the wire, pushing it flat as the tape covered it. The sensor wire was far thicker than the speaker cable being used for the contact microphones and in the end needed additional securing with more tape before having the final layer applied over the top.

There was over half a kilometre of tape and wire to coax around the walls and pipes of the building and the routes took creative planning. There were constant aesthetic decisions, and adjustments to those decisions, as the work took shape. Where should the wires convene? Should a particular wire move along the ceiling or run next to its partner along the duct? As such the tape map became a drawn response to the physical terrain across which it passed. In common with a Sol LeWitt wall drawing, its overall form was dependent upon a process that sat above it – the process of running a number of wires to and from particular points in a building – but unlike LeWitt's strict dictates, the determining process was flexible enough to allow for the occasional flourish, as lines of tape flowed together in intricate corners (figure 3) or carved diagonal highways across the exhibition walls (figure 4).

Figure 3: Outside the lift on the ground floor

Figure 4: In the gallery space

These small moments of visual idiosyncrasy aside, I was aware that the map had another function. As has been discussed in section 2.5, the tape map also functioned as signage, a guide to the work, and interpreting it as such was crucial to *Building Materials*' successful realisation. To this end I wanted the link to the London Underground map to be quite explicit. While my termini did not adhere to Transport for London's conventions, ending instead with a circle, each turn taken by the tape lines used either a 45 or a 90 degree angle, as in Harry Beck's original and each subsequent iteration of the London Underground map. These corners followed the tube map's practice of making direction changes rounded. In order that this be done with a measure of consistency, templates were laser cut in two millimetre MDF according to template diagrams I provided (an example is below in figure 5), circumventing unwelcome incursions by my unsteady hands.

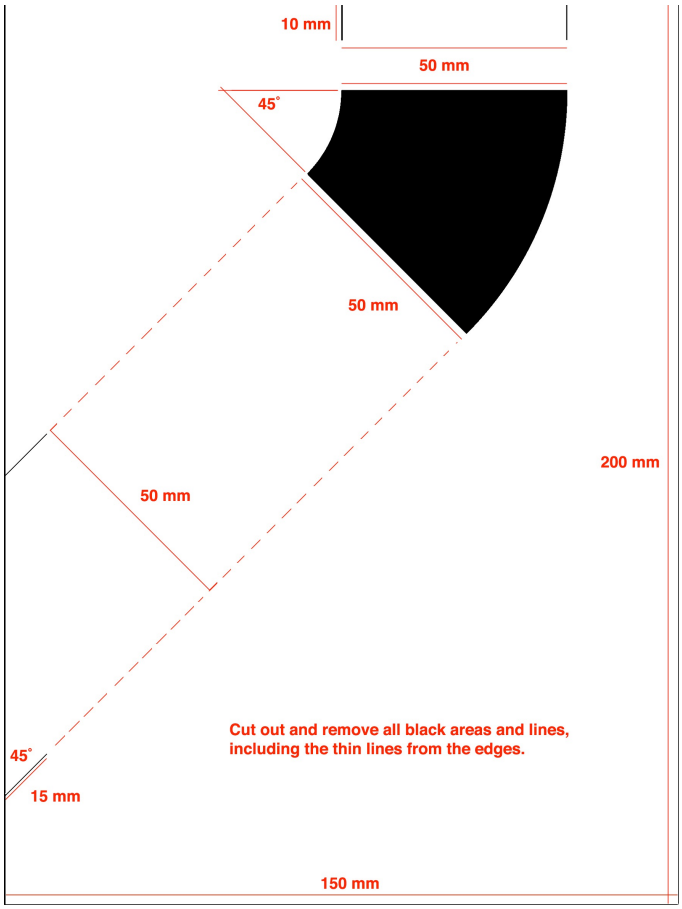

Figure 5: Forty five degree template

As the wires made their way back to the listening hub, and the computer that was their ultimate destination, I plugged in and listened. I had built sufficient flexibility into the Max patch for adjustment to take place in response to this moment, when I first heard the building itself rather than my polite rendering of it. The main adjustments were made to sensor thresholds, trying to make sure that events were triggered neither too frequently or too sparsely but adjustments to the sound were also necessary in reaction to a naively unforeseen auditory intruder, power hum.

It had been curiously unanticipated, the fact that running half a kilometre of wire through a large and busy public building, crossing a plethora of electric cabling, attaching it to microphones and listening to the result would uncover a dense forest of crackling noise, but it became something of a blessing. Another layer of spectral equalisation was employed to rid the sounds of the 220 Hz hum and its harmonics as far as was possible, and the results were good. But as this process wore on it became apparent that other actions within the building were now audible and that maybe it would impoverish the composition if too much hum was excised. Each time there was a fluctuation in the current the harmonic signature of the hum changed, and each time a switch was flicked there was a prominent click. Indeed the clicks could be used to trigger change within the composition in the same way that threshold events and other loud onsets were used. The hidden work of the Phoenix's machines could now manifest within *Building Materials*.

3.6 Background

In this section I will explore how the methodology behind *Building Materials* grew out of my professional practice as a composer and sound designer for interactive media. It began to develop in 1997 when I started designing sound for interactive installations and immersive web sites. But the specific impetus towards sonification as an approach came in 2000, from time spent creating the sound for an iteration of the MTV2 UK website with the digital agency Digit. This particular direction came as a direct result of a brief that stipulated a

musical character to the sound, as MTV2 is a music channel, but that avoided the ire of a very opinionated user base.

The solution to the brief arose as a result of the limitations imposed both by the brief itself and the technology available for its realisation. The site needed some sort of audio frame, one that would not be so foregrounded as to dominate the user experience but that would be sufficiently musical to support the branding. It had to underscore that fact that the site was about music and for people who were passionate about music. The major problem with an explicitly musical approach was one of file size. In 2000 the internet was still very much in the hands of dial up modems so the challenge was to produce a long form piece of music using small audio files. Software had just introduced streaming mp3 to the web with Macromedia Flash 4, so a sound file of around a minute's duration was possible, but only one, as more would impede the performance of the Flash player plugin. I was clear, however, that the music should be longer than one minute, users would be spending longer on the site and I did not want to just loop a piece of music. The new sound capabilities of Macromedia Flash 3 and, more significantly, Flash 4 made a more ambitious approach possible.

The solution I proposed was to somehow create the sound world, in real time, using the interactions of users on the site. In practice the amount of time available to spend realising this idea was limited, this was a commercial project with a strict production budget and developer man hours were restricted. The solution had to be simple to implement, so it became a long streaming sound bed, above which would sit a layer of many user triggered notes, activated as the site was navigated. There were five sections on the main menu and each of these sections would trigger one of three possible notes. These notes were cycled through in turn as each element was rolled over, making the musical outcome predictable but variable as the note sequence would change with each pass over the whole menu, and then modulate again if items were rolled over in different orders. In effect the site became a basic musical instrument as well as a very simplistic aleatoric composition. It had its basic rule set but the final form of the music was left open, the timescale it operated within was expanded to the totality of the time each user spent on the site.

The form of the menu itself was the main attraction of the site's design. It was developed in the period of time when designers for the web were exploring different models for user interaction. The agency Hi-Res! released their experimental website *Soulbath* (Schmitt & Yugovic, 1999) later that year, a site which explored malfunction and decay as part of its navigation and Daniel Brown's *Noodlebox* site had experimented with a reconfigurable navigation (Brown, 1998). But the MTV2 site was a large scale commercial venture rather than an experimental portfolio piece, therefore it was expected to function in an immediately usable way, whilst still having an exciting interface. The menu, shown in figure 6 (MTV2, 2000), was colourful and playful, made up of 3D elements that entered the screen in dynamic and cinematic ways, echoing the movements of hovering spaceships. It invited interaction and the sound reinforced this.

[Image redacted in this digitized version due to potential copyright issues]

Figure 6: MTV2 UK main interface (MTV2, 2000)

This playful environment of image and sound helped with the opinionated user base. As a result of their exploration of the interface I was not directly composing the music, the users were. This meant that their engagement with the music could be less passive, their involvement perhaps leading to a kind of investment in the music. In the end anecdotal response bore this out to a certain degree but there was still plenty of grumbling in the on site

chat spaces. Despite any dissent the site was a success, winning a BAFTA among other accolades, and going on to be included in the Digital Archaeology exhibition showcasing some of the most notable websites made in this era of nascent internet interactivity (Digital Archaeology, 2011).

In truth audience reaction was not the main concern for me, the delight for me was the simple rescinding of control. I did not consider it in any detail at the time but I felt, and still feel, a palpable excitement at the thought of other people composing my music for me, not as an act of performance but as a by-product of their independent actions. Moving forward, this methodology was developed further with the first version of my own portfolio site, www.repeat-to-fade.net (introduced in section 1.3). Working with the same developer who had programmed the MTV2 site, Thomas Poeser, I decided to make this model for internet sound the focal point of my own site.

I knew I wanted sonification to be at the heart of the user experience so with Thomas' help I designed the navigation around the sound. One of the reasons for the success of the MTV2 site was its engaging interface, its core simplicity was masked by a design that invited interaction. As the sound for repeat-to-fade was also to be built on user interaction, it was key that this interface should also be playful. But in addition the interface should enable a more detailed ruleset with which I could compose. File sizes were once again a restriction so I designed a sound engine based around multiple, asynchronously looping files, some were very short, creating longer single tones and textures when looped, others were much longer, crossfading in and out of each other to make a constantly shifting audio environment.

The files were triggered by rolling over eight vertically stacked bars (figure 7). Each time a bar was rolled over it filled up with its colour, from left to right, the amount it was filled dictated the behaviour of the attached sound and its volume envelope. These behaviours ranged from one shot plays of the file to the sounds constantly looping until you rolled over the bar again, each rollover using a different random sound from a large bank. When the bar was full it reset to empty, and two sounds cross faded up and down. The sounds themselves were taken from pieces of music I had made, I wanted to hear how the site could be used to reconstruct these pieces, either deliberately, or inadvertently, as a by-product of finding information.

[Image redacted in this digitized version due to potential copyright issues]

Figure 7: www.repeat-to-fade.net interface
(Poeser and Lloyd, 2001)

One of the key attractions with this particular model was this duality of experience. The site was an information resource, it showed people my work in order that I might get some more, but it was also a composition of sorts, waiting to be given life as it was used. Therefore, calling back to section 1.5 we find two states in which users acted upon the composition. When browsing the site for information their interactions with the sound were passive, they created the music through actions that were focussed elsewhere. But they could also choose to focus on the audio and realise the composition directly, as an aim in itself.

This duality presents an interesting tension. There is a sense in which this is a model for a sonification of user interaction, but it is a broken model. At the moment the user decides to use the interface for musical reasons the sonification stops, as the stream of extra-musical data becomes polluted by data with musical intent, and is replaced by a straightforward action/reaction interactive model. This shifting of interactive modes, from passive to active and back again (if more information from the site is required) excites me as it implies different modes of listening, highlighting different patterns of use for the listener. Once there is an awareness of the composing system, then there can follow an awareness of the how the music reflects actions that are blind to that system. A duality that is further explored in *Building Materials*.

Chapter 4

Outcomes

4.1 Introduction

This fourth chapter sets out the contextual and theoretical outcomes of this research. It introduces two terms which have arisen from of the in-depth consideration of the contexts and processes surrounding this research, installed composition and reverse mapping. I propose installed composition as a useful label for *Building Materials*, highlighting, as it does, that the focus of my practice was the production of a kind of music, which was given life and context by an installation. The phrase contains embedded implications of a work's ephemerality and its status as a piece of installation art in a gallery, and therefore its relationship to its physical and social context (Bishop, 2005). Installed composition also signals that the proceeds are composition rather than sound art, with the implied focus on a larger musical structure, rather than Salome Voegelin's apprehension of the stuff of sound as primary material (Voegelin, 2010). This is a term that I have since found used in a similar context only once, by Cathy Lane, but not in any instrumental way[5].

The study of sonification, allied to the consideration of the way in which maps communicate, leads to the introduction of the phrase reverse mapping. This term is used in the thesis to describe a methodology for parsing *Building Materials.* The process is set out by describing a hypothetical encounter with the artwork, and extended by using it to consider other works.

These two terms having been unpacked, the chapter continues with an expanded discussion of the interactive duality within the work and the way that interaction is discovered within *Building Materials* and how this might help communicate the process. The chapter concludes with a short exploration of my role as composer.

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[5] It is used by Cathy Lane, director of the Creative Research into Sound Arts Practice research cluster at the University of the Arts, London, to describe her work …*the pickle jar is her home*… (2009). This piece is a fixed composition which was played back as part of an installation in the group show Material Texts at Kashi Art Gallery, Kochi, India. She alternatively describes the work as a composed installation, as well as a sound composition and as such its status as an installation is unclear (Lane, 2010). In addition the term is not expanded on or considered further and its importance as a descriptor here seems similarly unclear.

4.2 Installed composition

In the introduction to this thesis I term *Building Materials* an installed composition. Having discussed sound art in section 1.3 and suggested that it is most usefully used as a descriptor with which to direct reception of an artwork, and with this work seeming a very suitable candidate for just that descriptor, why then have I decided to lead my audience in a different direction?

The word installed, rather than situated or site-specific, has been used carefully, as a sign that points to a more embodied reading of the work and the audience's role within it. 'Installed' implies a role for the audience within the work. In section 1.6 the idea of the decentring of the viewer in installation art was discussed along with its further implications for a viewer that is part of the art object itself. Bishop goes on argues that the 'need [in installation art] to move around and through the work in order to experience it *activates* the viewer' (2005, p. 11). In *Building Materials* this activation is made explicit by the invitation, made by the tape map, to interact with the work, thus exposing the audience to, and implicating them in, the process generating the music.

Secondly, in addition to this expanded role for the audience, the word 'installed' implies an engagement with the role of the building within the work. Where sound art can be used as a label to direct audience response to the consideration of sound as art material, here installed is used to highlight the use of Exeter Phoenix, or any subsequent setting, as art material. This implied relationship between setting and work within installation art draws attention to the fact that the building housing the piece is as active as the audience within it. Not only are the rhythms of its weekly use compositionally active but the sound made by its fittings and fixtures join those of its users to provide a raw sound world for *Building Materials* to make itself with.

And 'installed' also carries with it a sense of ephemerality. Once a work is installed then it follows that at the end of the exhibition it must be dismantled. This places a premium on the viewer's presence within the work, as there remains the sense that the work, when dismantled, is not currently existent and therefore unable to be experienced outside of the exhibition dates. Further to this 'installed' implies the possibility of many venues and underlines the

work's mobility and parasitic nature; moving from space to space to feed off each new environment it absorbs the narrative of each new building into its music.

Having specifically drawn attention to the installed nature of *Building Materials*, rather than used a broader descriptor such as art, I then link this term with composition, rather than sound. For me this is an installed composition, not a sound installation. Again the aim is to highlight my specific interest within the the abstract sound world on offer, an interest in the sound as music rather than as material.

This offers a different emphasis within the work, one which leans away from the single idea that the sound alone should be read. This work is, as Kane might agree, the sound and its context (Kane, 2013). And in a way, installed composition separates these two aspects of the work by implying a setting within which music occurs. Here, composition suggests a layer of sonic experience separate from any kind of contextual reading, the apprehension of sound as musical language rather than as a sign within a sonification. This separation seems almost perverse but it allows the work to exist in separate states, either of which can be accessed at any time. The work can be an abstract musical experience or it can be the sonified story of a building. Or it can be both, at once.

Installed composition seems a good descriptor for other pieces mentioned in this thesis. *The Place Where You Go To Listen* is certainly composed and certainly installed and *Particle Noise* can work as a sonification but its aesthetic holds very much to that of Nicolai's music. But if we delve deeper and view other work with installed composition in mind, does the term hold its value? Kubisch shies away from using the term music to describe *Electrical Walks*, instead she uses terminology that oscillates between situating the work as sound art and a kind of social research (Cox & Kubisch, 2006). Given this it could feel bullish to contradict Kubisch and call the piece an installed composition. But it feels problematic to separate the proceeds of *Electrical Walks* from an idea of music. Kubisch's aesthetic direction is present in each realisation of the work, the sounds marked on the map are not arbitrary but the results of her investigations of each new site's potential. A participant mixes sounds chosen by Kubisch according to the her map/score. So it seems there is sufficient compositional intent behind

each, site embedded, installation of *Electrical Walks* to describe it as an installed composition if received in such a way.

The last phrase in the previous paragraph reveals the worth of installed composition as a phrase. Kubisch's piece could very well be described as sound art, art, or as Kim-Cohen and Kubisch both also suggest, social research (Kim-Cohen, 2009). Each one of these phrases suggests a different focus for the work and prompts us to consider it in a new light. Installed composition does the same. The phrase directs our attention to the relationship between *Electrical Walks* and its situation, noting its use of its surroundings as an active agent within the work and even hinting towards its status as a sonification. Furthermore it suggests we consider the sounds we hear as music rather than sonic documentation and aligns the processes behind its creation with Lucier's compositional methodologies and indeterminacy.

So *Building Materials* is labelled an installed composition in order to highlight that the focus of my practice was the production of a kind of music, which was given life and context by an installation. There is, in this label, a recognition that the experience of the work will change after the event of its installation has passed, it signals the intention that the recorded proceeds cohere as a piece of music when removed from their setting, though awareness of the setting can still inform this disconnected reception of the work. There is also the confirmation of its status as a piece of art in an art gallery, with all the cultural baggage that the situation carries and demands attention to. And further to this 'installed composition' situates the work within its physical context, positing the idea of the work as parasite, assimilating each new venue into its sounding.

4.3 Reverse mapping

Earlier in this thesis I have used the phrase 'reverse mapping' to label a process whereby an audience can access an imagined narrative, a story built on clear signs given by a work. This process is built on sonification and mapping, as well as on choices made when deciding on the visual language of *Building Materials*. In this section I will attempt to unpack what amounts to a

conceptual model for the reception of the work that has arisen particularly from discussion around sonification and mapping, as well as what it is that I find of value within this idea.

Setting the idea of reverse mapping out as a methodology, the clearest way may be to make a list of perceptual steps and link them directly to the work. In some ways this is starting with the conclusion to this section but it provides a solid basis for further exploration. What follows, then, is a list containing the steps in a *possible* encounter with *Building Materials*, and how each steps builds towards an understanding that can prompt a narrative response to its music built on a position of informed speculation.

1. The tape map is encountered, leading to the beginnings of an awareness of the work's process for the audience. In this way the tape map acts like signage for the methodology.

2. Ludic exploration of the tape map leads to an awareness of the possibility for personal interaction within the work. But if we interrogate the nature of this interaction, bearing in mind what was discussed in section 1.5, we find a model of interaction that is neither direct nor indirect. The relationship between audience actions and the reactions of the work is more subtle. Cause and effect is certainly possible within *Building Materials* but the effects of any attempt at this are removed from the visitor trying to bring them about, simply by having them in a different space from the interaction. Actions play out in the extended warren of Exeter Phoenix, the resulting reaction of the work is heard in the gallery space, made discrete from the rest of the building by a glass door. In this way interaction becomes somehow speculative. The visitor can interact but can only guess at the results of her actions, similarly when in the gallery space and listening to the reactions of the composition, she can only speculate on what actions were their root. This position of remove from direct interaction makes possible a more objective relationship with the process behind the composition, which can be examined both from within – given that interaction with the work can take place – and without – as it is plain that cause is separate from effect.

3. This awareness of a visitor's place as an individual agent in the process gives rise to an understanding of the broader situation as a sonification of the surrounding space and the

people within it. This promotes the role of a visitor to the Phoenix who *isn't* directly participating in, or indeed who may be unaware of, the work, to that of a participant in the eyes of the visitor who has become aware of the process behind *Building Materials* as a result of the steps laid out above. It also reframes movements an audience member might make outside of the context of the piece – for example if they then went to a class in the building – as still being active in the work. The everyday cycles of the wider arts centre become embedded within the work.

4. The visual appearance of the tape map, as well as the new awareness of the work as a broader sonification, leads to an understanding that the *process* of mapping is fundamental to the creation of the composition. As was discussed in sections 2.3 and 2.4 this in turn imbues the story of the process with an implied objectivity with regards to its relationship with its surroundings, it is not a story about the Exeter Phoenix it is a story *of* the Exeter Phoenix.

5. This seeming veneer of objective 'truth', coupled with an awareness of the source of the composition – actions within the Exeter Phoenix being mapped to sound – gives the visitor a platform to reverse map sound events onto what she imagines has caused them, thereby building up a new imagined narrative to contextualise her hearing.

But if we remove the process of reverse mapping from *Building Materials*, can it add anything to an experience of another work? *Music on a Long Thin Wire* presents a compelling argument for the use of reverse mapping as a tool for enriching reception of a work. This is the result of the fact that when in the presence of the work its process is laid bare before the viewer. Lucier specifies in the score that the wire be lit in such a way that the '…modes of vibration are visible to viewers', thereby communicating the process visually within the physical work itself (Lucier, 1977). And yet precisely which phenomena from the surrounding space are actually enacting the changes a visitor hears in the sounding of the wire is unclear. The listener is in the space, witnessing the work sonify its environment, but she still has room to interpret the sound as she will. She can reverse map harmonic shifts and rumbles, speculating on their sources as she listens. This reading of the work is, in a way, transformative. The space of *Music*

on a Long Thin Wire changes from a purely sonic experience to a tangible environment, physical phenomena in the surroundings being subsumed within the stream of the wire's constant sounding.

With *Music on a Long Thin Wire* reverse mapping helps us gain the confidence in our interpretations to imagine *real* situations that we simply do not know about. The story told by the sound is simple and very human, boring even, but the sense of 'knowing' what is happening through listening to the music and, consciously or unconsciously, reverse mapping is what holds the attention. This is not an absolute knowledge, but I use it to suggest the link between what is heard and the real phenomenon producing it, an informed speculation based on knowledge of the compositional methodology, rather than a freeform imaginative response to the sound alone. A more direct example of reverse mapping occurs in *Game Music*, made in 2004 by Vladimir Todorovic (Todorovic, 2004). In this piece Todorovic used the computer game *Unreal Tournament 2004* as the agent behind his interactive compositions. He replaced the environment and weapon sounds within the game, producing an interactive space in which his music was the outcome. The compositions stand as documents of a game played, and with this knowledge we listen to them with a greater awareness and an anticipation of a particular structure, dictated by the method by which they are made.

Music on a Long Thin Wire is less explicit than *Game Music*, it resists such a confident interpretation. The interactions giving rise to *Game Music* are few and binary, the phenomena giving rise to *Music on a Long Thin Wire* are unclear even when in the presence of the work (Cox, 2004). The narrative can feel oblique, slippery. We think we know what is going on but the process contains so much chaos that we cannot really be sure and it is into this space, created by the tension between knowledge and uncertainty, that imagination erupts.

Looking back at section 2.4 it becomes important to stress that this system, outlined above, is not attempting to be what Barthes would call a semiological system. It is a process engaged with signs but the meanings of these signs shift according to how each audience member receives them. Their fluidity of meaning compromising their usefulness as a key to the work and their obstruction, through the separation of action from reaction in the work, being, for me, a fundamental aesthetic component of the work. It is a system that hints at the possibility

that it might be robust enough to rely on, but the possibility of effectively using it to parse *Building Materials* remains just out of reach. Instead reverse mapping more usefully fulfils the role of expanded context for the process, inviting the audience into the work while ensuring that they have room for their own interpretations and imaginations.

4.4 Interaction and duality

The duality inherent in the approach to the sound of repeat-to-fade.net, which I describe in section 3.6, was something I was keen to explore further. However the boundaries between interaction modes in *Building Materials* were by no means as absolute as they were on the internet. On a website, the range of action is limited by a constricted canvas. Actions operate on a single plane, within a small rectangle, and are also pixel specific and binary, the cursor is either on an active pixel or off it. When transposed to an entire building, in the analogue world outside of Actionscript, lines are drawn with far less clarity and the duality becomes less explicit. There was considerable reach for each of the points of possible interaction, microphones on glass doors picked up sound from a distance as well as reacting strongly to very local events, and the microphone on the frame of the lift was sensitive to events on three floors of the building. This meant that, with the possible exception of the microphone on the disused piano, there was never a clear point at which interaction with the work was, or was not taking place. There was also the fact that if interaction was intended, the duality of experience having been decoded, the user would potentially be travelling through other zones of interaction on the way to their chosen one. Passive and active interaction on one user determined vector.

In order to promote the more nuanced model of interaction outlined in sections 1.2 and 2.3, passive and active interaction, were not clear cut in *Building Materials*. The way in which the work was set up precluded a cause and effect interactive mode as all opportunities for interaction lay outside of the space within which the resulting sounds were heard. This meant that interaction was in fact more meaningful when uncoupled from any intent towards the work. Actions blind to the work were the result of a purpose which could be usefully fulfilled,

passing through a door to get into a lift, moving on a floor as part of a dance class. However, as we saw in section 2.5, when an action's focus was on *Building Materials* the separation of cause from effect rendered it speculative. The user would be unable to tell whether she had had any audible effect at all.

But she would be aware of the *potential* for an effect. This was key for me as my aim was for the context of the work to inhabit a potential reading of the work but not to explicitly direct the actions of the audience. In this way interpretive space was left for the audience, a space I often find absent in more directly interactive work. The difficulty I have with a more didactic model for interactivity is that it explains itself too clearly, the methodology is too readily decoded. Even a layered piece such as David Rokeby's *Very Nervous System* reveals its secrets with use, the video on Rokeby's website of him exploring the system shows a piece of work sensitive to user movements to the degree that its reaction becomes predictable (Rokeby, 1986). In an environment created for interactive composition this seems desirable and Rokeby seems to *know* what is happening. His movements are delicate, coaxing particular responses from the work and the effect can be delightful but there looks to be little room for user interpretation, the work seems a tool as much as a piece of art. In contrast a work like *Music On A Long Thin Wire* reveals little with any certainty, the net it casts in search of cause is spread wide to the point where an audience member cannot be certain if the effect on the sound they hear is due to their movement, or due to a gentle breeze (Cox, 2004). This broader interactive ecosystem, with its hazy boundaries and multiple interdependencies, creates an uncertainty which results in the kind of poetic speculation I wanted *Building Materials* to prompt. A space where the process was known but the specifics of its realisation remained uncertain.

4.5 Interaction and discovery

A kind of cross between an arts centre, in the style of the ICA in London, and a community centre, Exeter Phoenix is a warren of corridors linking spaces for dance and drama workshops with art and print studios, a radio station, a digital media centre, a recording studio and an auditorium for concerts, theatre and film screenings. The array of facilities orbits a hub

comprising a cafe/bar and the gallery spaces. This dispersal of activities throughout the maze of the Phoenix made the removal of cause from interactive effect straightforward, points of potential interaction could be a flight of stairs and a hundred metres distant from the listening space. This meant that once an awareness of the process had developed, the switch from a user's passive interaction may not have been to active interaction, so much as to a heightened awareness of the their use of Exeter Phoenix. This helped to avoid a situation where people's habitual actions within the building would be altered by the work to the extent that *Building Materials* sonified itself.

Figure 8: The entrance foyer

Upon entering the venue, the initial impact was visual. A multi-primary coloured trunk of tape lines rose from the top of the gallery door and, one by one, individual strands peeled off to scribe their journeys across the building (figure 8). The tape map seemed to feel like a Technicolor version of Italo Calvino's city of Armilla from *Invisible Cities*. Armilla is a city of pipework, where the rest of the buildings and infrastructure have been removed leaving only water conduits. Houses are networks of tubing ending in shower heads and taps, passing though ghost ceilings as they rise up from the ground (Calvino, 1972). It seemed as if the Exeter Phoenix could be removed and *Building Materials* would still describe its space.

This stream of coloured lines gave two immediate signals, firstly that the gallery was clearly the hub of something, and secondly that the something in the gallery was spreading out through the rest of the building. At this stage the relationship between the two spaces, the gallery/hub and the sprawl of the Phoenix, was unclear but there was the sense of a

possibility for exploration, in fact one of the first things that children tended to do was immediately start following the lines to their sources.

This invitation to a ludic mode of interaction and discovery had been hoped for and to see it in action was gratifying as I had wanted to avoid an over-reliance on an A4 information sheet to uncover the work. I have always found this way of disseminating information about a work clumsy and unhelpfully prescriptive. I am uncomfortable with the way in which they try to interpret, almost to solve, a piece of art for an audience, in the process, as Susan Sontag argues, diminishing the work and the receptions of its viewers (Sontag, 2009). I aimed for the tape map to be visually alluring enough, as well as sufficiently intriguing, for this ludic approach to take hold in some way, for people to discover the working of *Building Materials* as an adjunct to a kind of treasure hunt. In the end the desired lack of an information sheet was impossible, as the gallery uses their disappearance as an attendance indicator, justifying funding increases by evidencing visitor throughput with absent paper.

Still, this mode of playful discovery seemed to draw the audience in and fomented an engagement with the building that was separate from its primary function as an art centre. Visitors to *Building Materials* were on the lookout for signs outside of the usual context of the building. It altered movements through the space as people followed paths that ended not in toilets, studios, or a cafe, places of use that would normally be sought, but instead ended with buzzers, air conditioning fans, circles on windows looking balefully outside at the light of day – a set of vectors within the building but outside its usual purview.

These vectors were data conduits. Harvesting sound, light, temperature and activity from the building they funnelled it all back into the gallery where it poured down the wall and into the computer. As a data collection system it was effective, agile enough to change its focus within the building but not to the point where it became overly skittish. The proximity of the movement sensor to the gallery space provided a useful and obvious link between the circled sensors and the composition. While it was just close enough to hear that, when jumped about in front of, a difference had been made to the work, it was not quite close enough for a comfortable interaction space as, apart from having to make a fool of oneself in the public

lobby, the subtleties of the audio were out of reach. Still, effect could be confirmed to have been caused, a link discovered.

4.6 Composing and storytelling

The last strand I will unpick in this chapter reflecting on the stuff of *Building Materials*, its process and outcomes is how do I fit into it as composer? This is not a rumination on the issue of ownership, the work is far too managed for this to be a consideration and Cage's *4.33* speaks to this issue with considerably more force. This is more an exploration of my feelings when actioning this kind of compositional methodology. There seems to be an oblique egocentricity at the heart of a work like this. The piece is very open, its shape controlled by agents other than its composer. Yet there was the sense in which, as they were put to use, the actions and movements within Exeter Phoenix became mine, subsumed within my score. The composer became a kind of elevated being, looking down on the building from above, observing trigger points – bursts of activity, small interjections, gentle lulls – and so this position started to skew the narrative of the building as presented by the work.

The term 'score' in the paragraph above triggers a further exploration. There I use it very loosely, using the elevated position I imagine the composer inhabiting, to transform the Phoenix into a building plan with moving pieces, an active score with triggers awaiting action. But 'score' suggests a document that, when handed to a performer or realiser, allows a work to be completed with no further need for a composer. It is music distilled on paper waiting to be invoked again 'through the interpretation of signs' (Magnusson, 2011, p. 19). With *Building Materials* this is not the case. My input into *Building Materials* is needed for each realisation. Indeed my input for each new setting is not restricted to the choice of sounds and sensors but continues into the software. My instinct with this work is to filter the sounds through my aesthetic, both in terms of their dynamics and their textural, harmonic and timbral qualities. Perhaps this meddling augments the status of the composer in this instance as it suggests that the composer is also an instrument builder. So while *Building Materials* is composed, it is also built anew with each new sounding. The interdependent ecosystem of a building and its

inhabitants is transformed into a complex musical instrument which plays itself, resulting in my music.

So what kind of stories can this music tell? Exeter Phoenix is a peopled environment. Humans work there, aspire there, create success there, become disenchanted there. They have human stories and human lives. *Building Materials* reflected none of this – the casual poetry of everyday life – its narrative was one of architecture, of building as system. This is a direct result of its process, anchored as it is in sonification, in mapping, the translation of cause to effect. In a sense this approach to storytelling with music lies in opposition to the more traditional language of lyrical translation that we hear when listening to something like Claude Debussy's *Prélude à l'après-midi d'un faune,* or indeed to most of the musical output of the Hollywood studio system, with its predilection for narrative cues that try to prime the audience to react in a particular way to a particular moment; Chion's empathetic music (Chion, 1994). These methods present a translation of a fabula into the text of a well-established musical idiom that serves to communicate a very particular story, one external to the process of the music's creation. Sonification re-presents a story as a translation of the facts of its physical existence, its physical data set, into sound (Hermann et al., 2011). If we were to take the opening of a flower, perhaps musical cliché might suggest an ascending glissando on a harp. A sonification would take considerably longer, lasting for the time it takes for the flower to open in response to the heat of the sun, then taking in the gradual rotation of the flower as it tracks the sun across the sky and finally coming to a close as the petals draw themselves together again and dusk turns cold. This very literal mapping of event to sound produces a music that may lack a didactic emotional position concerning the phenomenon sonified but that leaves sufficient space for any response the audience's reception provokes. It is a translation of fact from one medium to another, a certainty of process that frees the audience to speculate, to imagine.

Conclusion

This practice based research reflects upon the tacit knowledge gained through the creation of the installed composition *Building Materials* in order to set it out as procedural knowledge. The research problems, as detailed in section 1.2, arise from the act of making a piece of music from a building and are given focus by my intuitive responses to this problem. These are then expanded, in section 2.3, into a set of methodologies through which the work, and others like it, can be created. The actual process of making the Exeter Phoenix iteration of *Building Materials* is detailed in the third chapter, giving an overall structure of increasing focus throughout the reflection on the praxis.

Through a detailed contextualisation of the work we go on to find that *Building Materials* sits at the intersection of a number of disciplines which have been previously discretely explored in my practice. The use of differing, sometimes obstructed, modes of interaction is combined with sonification and installation to produce a nuanced composition where the audience's role in relation to the work is in constant flux. Looking at contemporary works in similar fields there are clear links with installed interactive and sonification pieces but *Building Materials* stands distinct in its employment of many processes, often explored discretely by these other works, all at once. This results in a fluidity of focus where interaction states flow from direct, through direct but speculative – due to the barriers to a clear cause and effect cycle put in place by the work – to indirect interaction and the sonification of social space. Similarly the sonification moves from the physical facts of the building, such as the background processes of air conditioning, ice making and current switching, to then engage with the social movements within the different activity cells of the building.

This multiplicity of focus grows organically from an underlying process that is clearly signalled by the tape map. Knowledge of the process opens a space in the work for the audience to inhabit, their actions feeding the work, their experiences contextualising their listening. But a clear reading of the work is undermined by the changeable nature of the interactive relationships within the work. This in turn can lead to an imagined reading of the music and its cause through which a piecemeal impression of the surrounding context grows into a story of the building and the actions within.

The aesthetic implications of these readings of *Building Materials* are then used as a basis for developing an enquiry into work made using sonification and mapping. Such works sit in the ambiguous area wherein a practice that has a broadly scientific, and by extension seemingly objective, purpose – sonification – is repurposed as a tool for creative work, with all its inherent instinctive decision-making. This idea has been probed further. The processes of sonification and mapping have inherent potential for personal or institutional expression (Wood & Fels, 1986). As such we find them to be just as coloured by intuition and the desire to advance a particular purpose or point of view as a creative practice or the audience's speculations (Denil, 2003). This does not diminish these two processes but recognises that the audience's imaginings that they may prompt are no less secure, no more interpretive, than their triggers.

As the practice on which this research is based, the process of making *Building Materials* offered opportunities for tacit learning about its architectural and social context as a space for interaction. The third chapter explores how the iterative process behind the creation of the work, as well as the act of finessing the sound once the piece was installed in the space demanded a flexible approach to what *Building Materials* was. From consideration of what actions within the building could drive the work, through the detailed explorations of the sound material to the extension of its sonification afforded by the power hum, the act of making the work became an interrogation of the sounds and social rhythms of its setting. This interest in the sonification of social and practical actions and interactions develops and expands upon questions surrounding interaction that have arisen through my professional practice. In projects that have resonated particularly with me interaction is focussed on one of two modes, information gathering and musical interaction, the outputs of which are both always present. When viewed through the lens of sonification, this duality reveals an interesting tension in which modes of interaction pollute each other's data streams, compromising a sonification and complicating a reading of the resultant sound world.

The final chapter sets out my use of the terms 'installed composition' and 'reverse mapping'. In tandem they describe both a field of work, in which consideration of the agency of an environmental context within a piece of music is signalled within its descriptor, and a process through which this consideration can be enacted. These terms are crucial to my exploration

of the mechanics of sonification and mapping as compositional processes. Not only do they crystallise and situate my own work more precisely within the broad field of sound art, but the terms installed composition and reverse mapping function as crucial descriptors for rethinking and reconceptualising the role and theoretical implications of the use of sonification and mapping in creative praxes. 'Installed composition' is revealed as usefully discrete from 'sound art' and 'sound installation' when describing *Building Materials.* When discussing *Electrical Walks* it further reveals its worth, reframing the work's output as music made by its surroundings and its participants and recasting the process as composition rather than mixing. In so doing the term relates Kubisch's methodology to those of Lucier and Cage, suggesting other frameworks through which to view the work.

Having used 'installed composition' to signal the presence of environmental agency within a work, the term 'reverse mapping' describes a process through which this agency can be parsed, accessing inferred meanings that are implicit rather than explicit in the sound. While a participant in *Electrical Walks* can use Kubisch's map to point to blinking LED lights and smoke detectors as the source of what is heard, a visitor to an installation of *Music on a Long Thin Wire* is left to speculate as to what she is listening to. But this speculation can be informed by an awareness of Lucier's process. In such a case the mechanic behind this speculation can usefully be termed reverse mapping. This term signals that the speculation is based on a mapping of one fact, a phenomenon occurring, to another: sound. The resultant sound can be associated with a phenomenon by the viewer and, while their chosen source may not be the actual instigator of the sound, an overall picture of the phenomena acting on the wire can be built up. An imagined situation grows based on speculated mappings within a discrete range, the range being set by the viewer's awareness of the process behind the work. The sound has been reverse mapped to become the wind, the temperature, footsteps, rain.

The crux of this term is that it recognises these hypothesised reverse mappings as being just as valid as the actual mappings that instigate them. The word 'mapping' is used carefully. While 'translation' could stand instead, mapping is used to draw out associations with wider debates within cartography, and even to hint at Barthes' highlighting of the signification (here a sonification or mapping) as being 'a semiological system' rather than fact (cited in Wood & Fels, 1986, p. 63). This calls into question the objectivity of the mapping process which in turn

can elevate the status of a viewer's subjective response. In this way the term expands the context for the process by which a listener or viewer can parse work made using mapping as a fundamental mechanism.

Stepping back again from these two terms and looking more broadly at the research as a whole, what emerges is an ecosystemic approach to composition, a network of interdependent interactions, mediated by an artist, that cohere to make music. Within this strategy the repositioning of the composer as a facilitator of musical situations, rather than being a more didactic giver of musical instructions, is significantly augmented by the more recent field of sonification. Sonification in this guise facilitates the agency of the extra-musical, be they participants, phenomena or machines, and invites their stories to colour a work. It captures their rhythms, instincts and movements in sound where they manifest anew: traces, made music.

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