Toward a "Green" Organ:

Organ Building and Sustainability

by

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ABSTRACT

This study examines the effectiveness of various types of alternative resources in organ building in order to determine whether a change to more sustainable materials would benefit or hinder the overall sound production of the instrument. The qualities of the metals and woods currently used in organ production (e.g. lead, walnut, etc.) have been prized for centuries, so the substitution of different, more sustainable materials must be considered with regards to the sonic alterations, as well as the financial implications, of using alternatives to make the organ more "green."

Five organ builders were interviewed regarding their views on sustainable materials. In addition, the author consulted the websites of nine national and four international organ builders for information about sustainability, indicating that each organ builder defines the term somewhat differently. Decisions on the woods and metals to be used in building or refurbishing an existing organ are based more on the visual appearance, the sound desired, and the potential for reuse of existing materials. A number of sustainability practices are currently in use by organ builders in the United States and Europe. These include the reuse of transportation boxes, efforts towards recycled metal and wood pipework, and the use of high efficiency lighting.

The investigations into sustainable practice that are presented here document a variety of approaches to sustainability in organ building in the United States, Canada and Europe. This research should assist in the evaluation of further efforts to conserve valuable resources while ensuring the high quality of sound that has characterized the organ throughout its long history.

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CHAPTER 1

INTRODUCTION

Intent and Scope of Study

Certain instruments, such as guitars and woodwinds, rely on specific types of wood, known as tone woods, for their beneficial tonal properties resulting in each instrument's characteristics sound. Unfortunately, many of these precious woods are becoming dangerously close to extinction. This causes concern in the manufacturing of string bows, guitars, and woodwinds, all of which rely on these specific types of wood. While some surprisingly beneficial alternatives have been found for some of these instruments, the general trends in deforestation have yet to impact the construction of pipe organs.

The characteristic tonal properties of organ pipes are instead based on the shape of the pipe, the material – whether metal or wood, and a wide variety of voicing properties ranging from the wind pressure to the height of the pipe mouth cut up. However, one problem directly concerning organ builders is the use of lead in all metal pipework and soldering of electrical components. This caused particular concern in early 2006 when the European Commission sought to ban the use of lead entirely from all electronic devices.[1] The organ was narrowly added as the exception to the rule,[2] although,

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[1] Alan Cowell, "Europe Declares Pipe Organs," *The New York Times,* March 22, 2006, accessed on October 2, 2013, http://www.nytimes.com/2006/03/22/international/europe/22organs.html

[2] David Hemsley, "The BIOS column: British organ-builders lead Europe," *The Organ* vol. 85, August 2006: p. 62, accessed on June 8, 2014, ProQuest ID 1186437.

many European organ builders moved away from using lead in their soldering of the electrical components of the organ.[3]

Soon, perhaps, organ builders will need to find alternative resources as the materials on which they rely become unavailable or cost prohibitive. One builder noted the possibility of lead foundries closing soon due to the lead ban,[4] and it is also difficult to know how long the directives of the Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) will continue to allow the organ to be an exception in the lead restriction. The increasingly limited availability of this currently invaluable resource in organ building will eventually wreak havoc on the organ building community. Consequently, it is more beneficial to analyze and consider alternatives in advance of their mandated need.

This project is innovative for taking an early look at possible alternatives, as there is very little current research defining alternatives in organ building. By using historical contexts, the oral history of the instrument, and organology, this study aims to find possible sustainable alternatives. Previous research on the use of alternative matierals in the consturction of other instruments provides a basis on which to consider new possibilities with the organ.

Purpose of the Study

Although there have been studies examining possible alternative materials that are more sustainable for other instruments, there has been very little research on the use of

[3] Correspondence with Didier Grassin of Noack Pipe Organs, September 22, 2013

[4] Interview with Chris Holtkamp of the Holtkamp Organ Company, October 24, 2013.

sustainable materials in organ building. The purpose of this study was to examine the possibilities of employing sustainable practices used in organ building. The specific objectives included:

1. Determine the reason for using current materials (e.g. lead, walnut, etc.).
2. Examine whether a change in materials would cause a benefit or hindrance in the overall sound production.
3. Analyze the financial costs of using more sustainable materials within the context of the overall cost of an organ project.
4. Recommend possible alternatives to make the organ more “green.”

CHAPTER 2

PERSPECTIVES OF HISTORICAL ORGAN BUILDING

Organ Building Treatises

Organ building treatises are a valuable resource for information about what types of materials have been used in organ building, specifically in regards to woods and metals. Of particular importance, though, some treatises also provide insight as to *why* certain materials have been used for organ building.

Audsley's *The Art of Organ Building*, published in 1905, includes the most comprehensive discussion of which woods were used in organ building, with great detail on the variety of woods available, such as such as pine, spruce, poplar, oak, maple, mahogany, black walnut, and even teak. Typically, though, Audsley's recommendations suggest whichever wood is free of general blemishes is suitable, but the author claimed oak as the best.[5] Hopkins' treatise, *The Organ*, also confirmed the importance of using untarnished wood in his discussion of the habits of the English builder, Father Smith, who would "never use any [wood] that had the least flaw or knot in it."[6] Hopkins noted the regular use of cedar, deal, pine, and oak, but mentioned the use of mahogany as being beneficial for instruments located in hot climates.[7]

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[5] George Ashdown Audsley, *The Art of Organ-Building: A Comprehensive Historical, Theoretical, and Practical Treatise on the Tonal Appointment and Mechanical Construction of Concert-Room, Church, and Chamber Organs* (New York: Dover Publications, 1965), p. 431.

[6] Edward J. Hopkins, Edward F. Rimbault, and William Leslie Sumner, *The Organ, Its History and Construction* (Hilversum [Holland]: Frits Knuf, 1965), 100.

[7] Ibid., 100.

Organ builders were more inclined to write about the benefits and importance of using particular metals, namely tin, lead, and zinc. Most organ builders wrote about the favorability of tin for organ pipes, and sharply criticize the use of lead. Hopkins claimed the use of tin to be "first in point of excellence…for organ pipes by its great durability, its superior silver colour, and its lightness."[8] However, while the hardness of tin helps with sturdy intonation, its low melting point of 442^{o}F requires at least a small portion of lead, melting at 612^{o}F to aid in the workability of this new alloy.[9] Hinton further argued for an alloy of both materials noting that "there is no such thing as 'pure tin' in use; nearly 10 per cent of lead *must* be mixed with tin to render it workable."[10]

Schlick likewise extoled the use of tin, and also seemed to concede to the use of lead with this mixture: "Some mix together half tin and half lead, less or more as seems good to each. But it seems to me that the less lead and the more tin, or pure and all tin, is much better and more enduring."[11] Schlick voiced further concerns about lead in general: "Lead is not as long lasting or durable as tin, for lead easily oxidizes from dampness, and holes appear in it from decay…For these and other reasons, lead, in its pure state, is not suitable to be used for pipes."[12]

Schlick was perhaps the first to comment on the perceived auditory difference between tin and lead, and believed lead pipes to be "sweeter sounding than those of

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[8] Ibid., 96.
[9] Ibid., 97.
[10] John William Hinton, *Construction* (Buren, The Netherlands: F. Knuf, 1992), p. 68.
[11] Arnolt Schlick, trans. Elizabeth Berry Barber, *Spiegel der Orgelmacher und Organisten: (Mainz 1511)*, (Buren, the Netherlands: Frits Knuf, 1980), p. 55.
[12] Ibid., 55.

tin."[13] Fisk, too, claimed lead pipes have "a darkness, a hollowness, a sound as of deepest antiquity [and] a strength of sound."[14] Conversely, tin pipes have the "sound of refinement" as "tin loves to produce overtones."[15] Smit remarked that "the sound produced by the pipe should not necessarily be affected by the material of which the pipe is made; i.e. the pipe body itself should not resonate, only the air within."[16] This raises an important debate, to be discussed further below, regarding the relationship between the material used and the effect of tone produced.

Regarding other metals, many organ building treatises seemed to agree on the general unsuitability of zinc as a metal for pipework. Hinton wrote that "zinc, while possessing some special advantages for fronts – in being less susceptible to injuries, and cheaper – never gives a really *round* and musical tone."[17] Sonnaillon also claimed zinc to be "a metal whose tonal virtues are less than evident."[18] However, there are many other materials once used by organ builders that may make one question the "tonal virtues" of these materials as well.

Bédos de Celles, in his monumental, eighteenth-century treatise *L'art du facteur d'orgues*, commented on the wide array of materials used since the origin of the organ, including gold, silver, copper, bronze, brass, alabaster, glass, and even pipes made of

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[13] Ibid., 55.
[14] Charles Fisk, "Some Thoughts on Pipe Metal," *The American Organist* 21, no. 4 (April 1987): 73.
[15] Ibid., 73.
[16] "Metal Pipes – Part I: Metallurgy," David Smit, accessed September 30, 2014 http://www.albany.edu/piporg-l/pipemet.html.
[17] John William Hinton, *Construction* (Buren, The Netherlands: F. Knuf, 1992), p. 11.
[18] Bernard Sonnaillon, trans. Steward Spencer, *King of Instruments: A History of the Organ* (New York: Rizzoli, 1985), 28.

playing cards.[19] Though, he clarified the purpose for these materials: "It would seem that these materials were used only for curiosity and oddity, without claiming that they were better suited to this purpose."[20] Additionally, Andersen mentioned glass, stiff cardboard, and porcelain as well.[21]

While the workable quality and perceived tone of various metals were the primary concern for deciding which metal to use, finances, too, have been an important aspect. Hopkins claimed tin to be upwards of six times as expensive as lead,[22] and Schlick claimed the use of lead on the hintersatz is due to the lower cost.[23] The increased cost of tin in the 1970s perhaps contributed to the rise in the use of zinc. Charles Fisk remarked that the cost of tin rose from $3/lb to $6/lb in a span of five years.[24] This added cost, in relation to the general high cost of building an organ, caused organ builders to seek other options. Zinc provided this option, especially for larger bass pipes, though its tough critique seems perplexing. As discussed by Smit, zinc has never been thought of favorability, except for its economical characteristic; in fact, he claimed that zinc was not employed as a pipe metal prior to the nineteenth century.[25]

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[19] Bédos de Celles, François, trans. Charles Ferguson. *The Organ-Builder*. (Raleigh: The Sunbury Press, 1977), p. xxxiii.
[20] Ibid., xxxiii.
[21] Poul-Gerhard Andersen, *Organ Building and Design*, trans. Joanne Curnutt (New York: Oxford University Press, 1969), p. 35.
[22] Hopkins, 97.
[23] Schlick, 55.
[24] Fisk, 73.
[25] "Metal Pipes – Part I: Metallurgy," David Smit, accessed September 30, 2014, http://www.albany.edu/piporg-l/pipemet.html

Consequently, the metal commonly used for pipework is an alloy, a metal made by combining two or more metals, including such types as common metal (30% tin, 70% lead), spotted metal (50% tin, 50% lead), and plain tin (75% tin, 25% lead).[26] The exact combination of metals used for a spotted metal alloy could change to a slightly higher lead content, and a lower tin content. Fisk suggested this was done due to financial reasons.[27] Additionally, Fisk claimed it was G. Donald Harrison, of Aeolian-Skinner, who dramatically increased the use of tin in American pipe building. Ultimately, the varying degrees of workability, integrity, cost, and perceived sound production decides the type of metal to be used by organ builders.

The Organ "Tradition"

The "Tradition" of the organ and ensuring its survival is perhaps the primary goal of both organ builders and organists. Unfortunately, it is this same overwhelming support of the history of the instrument that makes builders and organists slow to adapt to changes. The organ has the longest history of any instrument and arguably the largest repertory of music; organists and builders alike take great pride in this history. The work of organ builders of the past are idolized, and with increasing efforts in the Historical Performance Practice realm, recreating memories of the past is even more important. U.S. organ builders over the last 100 years have spent more time travelling to Europe, taking measurements and scans of the pipes material, thickness, mouth cut-ups, and any other

[26] "Online Catalogue," Organ Supply Industries, accessed October 2, 2014, http://www.organsupply.com/catalog_ordering/view_our_catalog/catalog.vnx, 9-2.
[27] Fisk, 73.

measureable aspect of the organ so that they could be inspired and better informed about how to make these instruments anew.

So, there is a paradox created. How can we support our tradition and everything in the past and yet still evolve? Did not Cavaillé-Coll change the style of organ building with his instrument at St. Dénis? In the same way, did not the colors and sounds of the Hildebrandt organ at St. Wenzel's in Naumburg inspire J. S. Bach in his large *ClavierÜbung III* at the end of his life? Certainly his use of the Naumburg Kyrie for his large Kyrie setting would suggest this. So, while we look to the past for inspiration, the ideas of sustainability could perhaps change again the face of organ building, but for the better. The improvements and advancement in technology and resources available have changed dramatically from the time of Hildebrandt, and even since the time of Cavaillé-Coll. Certainly, while saving the work of the past is important, in a matter of time, what is done today will be the "past" of the future.

The famous architect, Frank Gehry, known for his innovative ideas, worked closely with Manuel Rosales in planning the façade of the Disney Hall organ in Los Angeles. Not being familiar with the organ, he did not know what was otherwise impossible, which lead to some very fascinating brainstorming sessions – even a wild idea of hanging the festival trumpet pipes from the ceiling! In the end, the large angular pedal pipes at the front of the façade are also curved. Rosales was unsure if the curved pipes could speak properly. However, in fact, Rosales found that the speech, attack, and tone was actually improved by the slight curvature of the pipe![28]

[28] Jennifer Zobelein and Jonathan Ambrosino, *A Forest of Pipes: The Story of the Walt Disney Concert Hall Organ* (Los Angeles: Balcony Press, 2007), p. 15.

Being unfamiliar with the organ means being blissfully naïve of its limitations. The benefit of lacking a certain understanding of the "Tradition" of the organ, allows the possibility of new ideas to be generated that an organist or organ builder may not think of naturally. Perhaps drawing on the principles of sustainability as used in other areas, can inspire new and better options, as was the case with the "Green Line" woodwinds and Composite Acoustic Guitars discussed below.

Sustainability and Instrument Building

Precious tone woods used by instrumentalists such as woodwinds, guitars, and strings, are becoming dangerously close to extinction. These woods have come under the protection of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), an organization charged with ensuring the protection of the earth's resources. Through a series of appendices, CITES regulates the use of certain plant and animals to varying degrees depending on the survival threat of that species.[29] This has prompted instrumental manufacturers to begin considering alternatives in building.

The leading organization currently providing fully sustainable options for wood is the Forest Stewardship Council (FSC). This non-profit organization, founded in 1993, promotes environmentally sound, socially beneficial, and economically prosperous management of the world's forests. To ensure forests are responsibly managed, FSC

[29] "How CITES Works," CITES organization, accessed September 23, 2013, http://cites.org/eng/disc/how.php

controls the overall market demand for certain types of woods.[30] Additionally, companies who use FSC certified woods in their products can use this in their marketing. However, the difficulty is, unless every part of the instrument is made with FSC material, the instrument cannot be officially labeled FSC certified.[31] In the case of a guitar, this means even the bridge and tuning pegs must be made with FSC certified wood. While this makes it more difficult for labeling, and perhaps complicates the advertising process, it can still be used in marketing, demonstrating the companies' efforts toward sustainability.

One such dwindling resource is African Blackwood, a particularly knotty-growing tree renowned for its tonal resonating properties used by the woodwind family. The Buffet group has developed a "Green Line" of woodwind instruments, which molds together residual dust and unusable pieces of African Blackwood with a special resin. Because the material of the instrument is still African Blackwood, the specific tonal characteristics of the instrument are maintained. Incidentally, the increased density of this new material makes it less susceptible to the elements, such as fluctuations in temperature and humidity. In a listening test comparing this new instrument and a "traditional" clarinet, this innovative new product was actually preferred.[32]

Additionally, guitar companies have begun searching for alternative materials to use. Composite Acoustic Guitars builders have turned to carbon fiber, an entirely sustainable material, insusceptible to the elements, and a denser material than wood.

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[30] "Mission and Vision," FSC US, accessed September 23, 2013, https://us.fsc.org/

[31] Gerken, "Alternative Tonewoods," p. 62.

[32] "Green as a Lifestyle, a Way of Doing Business: Part II – Manufacturers and Suppliers Move Forward in Surprising Ways," *Musical Merchandise Review* 171, no. 7 (July 2012): p. 45, accessed on August 30, 2009, ProQuest Doc ID 1041302476.

These guitars produce "a very rich, dynamic and loud tone," due in part to the increased density of the carbon fiber material.[33] This raises an important point in the discussion of alternative materials, as the company aims "not to replace traditional woods, but to provide a better alternative."[34]

Research on Organ Building and Sustainability

There is currently no research on sustainability issues as they relate to organ building. Likely, this is because there has not been a large enough threat to the materials used in organ building to warrant such investigation. Interestingly, in his organ building treatise from the turn of the century early, Audsley suggested that cherry "is admirably suited for the construction of the finest description of wood pipes," yet he continued by suggesting "this valuable wood has been so largely used for ordinary joinery in the United States that it is likely to become scarce and expensive."[35]

While the "Tradition" of the organ sacredly guards the "proper" materials to be used, some of the materials used have been far from traditional, as discussed above. Sonnaillon summarized this beautifully: "The choice of materials depends, therefore, partly on the organ builder's own preference concerning the tonal character of the pipe in question, partly on the prevailing climatic conditions, and partly of course on the amount

[33] "Spotlight – 'Going Green' Still Going Strong …: Part 1 – For Guitar Makers, the Stakes are Higher," *Musical Merchandise Review* 171, no. 6 (June 2012): p. 36, accessed on August 20, 2009, ProQuest Doc ID 1151735155.
[34] Ibid., p. 36.
[35] Audsley, p. 429.

of money available."[36] In fact, the notion of a "builder's preference" suggests the importance of one's perception as to the best material to use.

Many organ builders strongly believe that the type of material used impacts the sound produced. Andersen vehemently disagreed with this notion, and claimed the material used for organ pipes is almost superfluous:

> It is a common misunderstanding that the material of pipes, metal or wood, determines the quality of the sound, and that this material even creates the vibrations, like a string or a bell. This is not true. The tone is produced by the air column which is confined in the body of the pipe, and the sole function of the pipe walls is to enclose the air column and provide it with the correct dimensions …When the pipe material is selected, consideration must also be given to purely practical matters such as manufacture, stability and price; and just because the air column in the pipe and not the pipe wall is the sound-producing element, practical considerations will often have a decisive influence on the choice of the pipe materials.[37]

Andersen claimed, too, that even "the difference in tonal quality between wooden pipes and metal pipes is more dependent upon the form of the body [or shape of the pipe] than upon the material."[38] Scientific research has been done regarding this issue as well. In 1965, after extensive measuring and comparing different materials, Backus and Hundley came to the following conclusion:

> The steady tone of a pipe does not depend on the material of the pipe wall. The belief that the use of tin in constructing pipes gives a better tone appears to be a myth unsupported by the evidence. The main reason for the use of the usual tin-lead mixtures would seem to be the practical one of ease of working and pipe voicing. There is also a psychological factor; tin

[36] Sonnaillon, p. 28.
[37] Andersen, 35.
[38] Ibid., 26.

> is expensive, and it is natural to think of a more costly pipe as producing better tone.[39]

In citing previous work, Backus and Hundley noted the experiment completed in 1940 by Boner and Newman. In comparing various metals, a wooden cylindrical pipe, as well as a pipe made of a sheet of wrapping paper. "Listening tests made on these pipes showed very small audible difference."[40]

Andersen's point regarding practical considerations, suggests finances as a decisive factor. As with Audsley, the reason cherry is not extensively used for organ pipes is due to its cost prohibitive nature. Consequently, this research paper will also explore the financial aspect of alternative materials in organ building. However, in early discussions with organ builders, as only about 10% of the overall cost is the materials used,[41] even if a type of sustainable wood is slightly more expensive, the added value of this material may hardly be noticed in the final total cost.

Restorations/Rebuilds

One sustainable aspect of organ building is not often initially recognized as sustainable. Organ builders are frequently hired not to build a new organ, but either to restore or rebuild an organ that has fallen into disrepair. In this method, an organ is refurbished either completely, or in part, to create a new instrument. Builders recycle the best part of the instrument, and discard that which is unusable. The importance of this

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[39] John Backus and T. C. Hundley, "Wall Vibrations in organ pipes and their effect on the steady state tone quality," *The Journal of the Acoustical Society of America* 39, (December 1965): 945.

[40] Ibid., 937.

[41] Correspondence with Paul Fritts of Fritts and Co. Organ Builders, September 23, 2013.

dates back at least to the seventeenth century when Andreas Werckmeister noted the importance of being cautious when rebuilding an old organ, humorously claiming "many a builder has dismantled something far better than what he built in its stead."[42]

However, in rebuilding instruments, there is also particular homage paid toward the builders of the past. Schnitger was known in particular for his great respect for builders of the past. Peter Williams stated:

> Schnitger seems to have had great respect for old material … Both Schnitger's careful use of old pipes and his well-planned employment of many apprentices can help to explain some of his organs' inconsistent qualities, such as the differences in scaling between one organ and another of comparable size and scope.[43]

In the nineteenth century as well, Cavaillé-Coll saved much of the historic Cliquot pipework when he rebuilt and enlarged the instrument at Saint Sulpice. Cavaillé-Coll, too, was also an earlier pioneer of sustainability by repurposing what may have otherwise been discarded, such as using sawdust in his swell shades to add density, drastically improving their function in the process.

However, the difficulty of reusing pipework hinges on the quality of the pipework at the time of the rebuild. The period of organ building promoted and made feasible by the Industrial Revolution meant many organs were manufactured, as opposed to being built. Clients could order from a catalogue to request the model that they wanted. This was great from a mass production and affordability perspective, and it meant thousands of churches received organs with a quick turnaround. However, the quality of these

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[42] Andreas Werckmeister, trans. Gerhard Krapf, *Erweiterte und verbesserte Orgel-Probe*, (Raleigh: Sunbury Press, 1976), 50.

[43] Peter Williams, *The European Organ 1450-1850* (Bloomington: Indiana University Press, 1966), 112.

organs is particularly suspect. Consequently, when it is time for the organ to be updated, saving these instruments by way of a historical restoration is largely unnecessary. There are perhaps parts to be reused in the final project, but restoration work is a more intricate craft, protecting each part of the organ as its primary directive.

Scaling is a property of organ building that gives each pipe a characteristic sound. The predominating sound of organs in the 1950s to 1970s was much brighter than the current trends. All things being cyclic, the bright tone was a reaction against the heavy foundations at the turn of the twentieth century, and thereby more recent trends have tried to turn away from the bright sound of the consequent reactionary period. This brighter sound is caused by more narrow scaling on high wind pressure. This means, in relation to the height, the pipe is very narrow; the sound lacks any roundness of tone. For an organ builder, it is easy to shorten the pipe length, thereby making the pipe wider in comparison to the height. This darkens the sound, and is an easy fix.

Reusing and repurposing these shortened pipes is fairly straightforward; however, going the opposite direction is more difficult, if not cumbersome. As the pipe is cut to create the specific diameter, it is hard to make the diameter wider. While trimming the pipe down makes it wider, to make a pipe taller in order to narrow the scaling is typically done in one of two ways; organ builders can add a slight sleeve around the pipe to give height, or, alternately, they can weld an additional piece of pipe on top. The work involved in making such changes and the ensuing sound determines whether a rank of pipe is saved by an organ builder.

CHAPTER 3

ATTITUDES TOWARD SUSTAINABILITY IN ORGAN BUILDING

Although there have been studies examining possible alternative materials that are more sustainable for other instruments, there has been very little research on the use sustainable materials in organ building. The purpose of this study was to examine the sustainable practices used in organ building. The specific objectives included: determine the reason for using current materials (e.g. lead, walnut, etc.); examine whether a change in materials would cause a benefit or hindrance in the overall sound production; analyze the financial costs of using more sustainable materials within the context of the overall cost of an organ project; recommend possible alternatives to make the organ more "green."

This section describes the methods used to collect data on sustainable practices in organ building. Three sources of data were consulted in this study: historical organ building treatises, which offer insight into trends of the past; interviews with present organ builders, which provided insight into current practices; and organ builder websites.

Organ Building Treatises

Ten organ building treatises were reviewed. These treatises, in addition to covering information about general organ building, supply information about *why* certain materials are used. These treatises trace the overarching theme that sustainability has not been a cause for concern for organ builders when it comes to the materials used. They provide the foundation knowledge to give insight as to why particular materials are still used today.

Interviews with Organ Builders

A total of nine organ builders were contacted by email to request their participation in an interview for this study (see appendix A). Five organ builders (56%) agreed and participated in an interview via telephone or Skype, with additional communication via email. Participants included four organ builders in the US and one organ builder from Europe (see Table 1). The interview guide (Appendix B) details topic areas addressed in the interviews. Each organ builder interviewed agreed to the informed consent document (Appendix C) prior to the interview. Some of the interviews were audio recorded to facilitate dialogue between the researcher and organ builder.[44]

Organ Builder Websites

A total of nine national and four international organ builder's websites were also reviewed (see Table 1). Many of the websites provided detailed information about the practices of the organ builder's shop. The website review focused on sustainable practices used by the organ builder.

[44] The researcher completed CITI human subjects training prior to beginning the research. The study was reviewed and approved by the Arizona State University Institutional Review Board (IRB). The IRB letter of exemption status, which approved the use of the recruitment script, interview guide, and consent form, is included in Appendix D.

Table 1. Organ Builder Information

Company	Website	Name of Interviewee
Allen Organ Company	http://www.allenorgan.com/	
Berghaus Pipe Organ Builders, Inc.	http://www.berghausorgan.com/	Kelly Monette
Dobson Pipe Organ Builders, Ltd.	http://www.dobsonorgan.com/	John Panning
Randall Dyer and Associates	http://www.rdyerorgans.com/	
Fritts and Company Organ Builders	http://www.frittsorgan.com/	
Hey Orgelbau	http://www.hey-orgelbau.com/	
The Holtkamp Organ Company	http://www.holtkamporgan.com/	
Kuhn Organ Builders, Ltd.	http://www.orgelbau.ch/	
Noack Organ Company	http://www.noackorgan.com/	Didier Grassin
Orgelbau Klais Bonn	http://www.orgelbau-klais.com/	Philipp Klais
Pipe Organ Builders Fratelli Ruffatti	http://www.ruffatti.com/	
The Reuter Organ Company	http://www.reuterorgan.com/	Bill Klimus
Rodgers	http://www.rodgersinstruments.com/	

CHAPTER 4

CONTEMPORARY PERSPECTIVES ON SUSTAINABILITY

Introduction: A Disclaimer

All organ builders are quick to acknowledge the dedication and pride they invest into each highly specialized work of art. Each instrument is tailored to match the needs of the client from the stop list specification, to the appearance of the organ as mandated in part by the space in which it resides, to the inevitable financial constraints and the consequent creativity to work around such confines. Consequently, while the interviews provided great information about an organ builder's craft, generalizations even among the small pool of organ builders are nearly impossible.

For example, while only one builder mentioned the use of Carpathian elm burl, this does not suggest the avoidance of this wood by any of the other builders, but rather it was often simply not mentioned, and any reasons as to why are speculative. Claiming that only one of five builders mentioned using Carpathian elm burl, suggests a stronger statement than is merited. As an artist uses various mediums to create art, so, too, do these builders and this fact likely reflects an artistic choice, rather than a stance against another option.

Instead, the results presented reflect some of the variety of possibilities used by builders. In particular, the focus of these interviews centered on efforts of sustainability, though the definition of this term and degree of importance placed on the concept varied among all builders. In such an instance, generalizations are more possible, noting specific areas where some builder's sustainability practices excel. However, the extent to which all of these builders seemed open to new ideas must be applauded. In sharing the insights

learned, perhaps future ideas will be generated, allowing the continued evolution and development of the organ to continue.

Wood

The most common wood used by American organ builders is poplar. Respected for its versatility, availability, and locality, this wood is a fast-growing wood in the eastern United States. Poplar is noted as a "utility wood,"[45] as its natural grain is not of the quality usually demanded for fine wood furniture. However, as the majority of the organ is not seen, the visual appeal of this wood is largely moot. Additionally, as a great receptor wood, this wood takes stains and veneers quite successfully, providing an alternative should the wood need to be visible.[46]

Poplar is softer in nature, and while it is beneficial for pipework because of the ease of workability, one organ builder suggested that it is not as beneficial for casework as poplar's softness shows wear and tear easier.[47] Two other builders suggested poplar for the case, especially if painted, is fine,[48] having noted the receptor nature of this wood.

One organ builder commented that poplar is also preferred because it is easy to have large pieces of poplar free from knots and blemishes.[49] Large 16 foot and 32 foot

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[45] "Poplar" The Wood Database, Accessed Oct 2, 2014, http://www.wood-database.com/lumber-identification/hardwoods/poplar/

[46] Ibid.

[47] Correspondence with John Panning of Dobson Pipe Organ Builders, September 4, 2014.

[48] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014 and Correspondence with Paul Fritts of Fritts and Co. Organ Builders, September 23, 2013.

[49] Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.

(16' and 32') pipes require an extensive section of wood free from impurities, but this creates a challenge to find a piece of wood this large and clean. Additionally, as there are four pieces of wood combined together to create the open wood pipe, a substantial amount of wood is required for a entire full-length open wood 32' rank of pipes.

Regarding casework, organ builders all commented that a wide variety of woods can be used. The actual wood used depends largely on the surrounding area. Organ builders are particularly sensitive to the environment – physically and visually – of the organ's new home. And, certainly the visual appearance of an instrument, from the design of the pipes to the woodwork of the case play an important role on the interpretation of how an organ sounds, as dramatic façades such as the Walt Disney Hall organ demonstrate.[50]

Consequently, if the room housing the organ is built in colonial style, using poplar painted white, or even marbled, to match the interior can be quite effective and economical.[51] Whereas, a Georgian architectural-style space might require a more costly wood with staining to match the darker woods often used. Many spaces that will house an organ use oak as the primary decorative wood, and this can be used often for organ building. However, sometimes, woods are taken more literally from the environment. Orgelbau Klais in Germany uses teak or mahogany for instruments built in Asia, as those woods are already adapted to the local environments and the time spent seasoning the

[50] For a picture and information on this organ, please see http://disneyhallorgan.com/
[51] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014.

wood is diminished.[52] Additionally, cases built with woods from the area will appear as though the instrument has always belonged there.

Organ builders mentioned the use of several other woods for various reasons. Harder woods such as cherry, walnut, or maple are used around the mouth of the organ pipe to allow for more control in the voicing process.[53] Regarding the organ console itself, this tends to be a place organ builders use more exotic woods. Bill Klimus, of the Reuter Organ Company, noted that people consider the organ console to be the actual organ, so it is important for it to be visually striking. Further, he emphasized the importance of using very stable hardwoods for the console, such as oak, so they will be unaffected by environmental changes.[54]

Wind chests and toe boards also need to be insusceptible to the environment, as such changes can cause air leaks and ciphers. This means using woods that have been sufficiently seasoned so they will not dry or crack. Panning mentioned the use of medium density fiberboard (MDF) veneers on their toe boards, as the strength of this material helps ensure constancy in seasonal changes.[55]

Kelly Monette of Berghaus Pipe Organ Builders, explained further the benefits of MDF. While using a bonding agent to form wood fibers together, MDF can be engineered to a variety of thicknesses.[56] The difficulty, he noted, is that the boards must be sealed properly, providing a finished exterior. Cutting into MDF after it has been

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[52] Interview with Philipp Klais of Orgelbau Klais, August 11, 2014.
[53] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014.
[54] Ibid.
[55] Correspondence with John Panning of Dobson Pipe Organs, September 4, 2014.
[56] Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.

sealed releases toxic particles that are dangerous if inhaled.[57] MDF is the only composite material used by any organ builders, and it is used sparingly at the moment because of the precautions required when working with it. However, there are parts of the organ, such as toe boards, swell boxes, wind trunks, that would not be cut into such as is required for voicing of wind pipes. Additionally, as organ builders discussed the possibility of using different woods for the mouth of the pipes, perhaps MDF could be used as the material for the pipe body.

Organ builders in Europe use woods that are specially certified, and in Austria, builders are required to prove evidence of where they received their wood.[58] The most common type of certification is Forest Stewardship Certified (FSC) wood. Some companies offer this as an option, such as Dobson, but Ruffatti regularly makes use of FSC Mahogany in all aspects of their organs. While Klais did not use the term FSC, they use a wood, even for their packing materials, that carries a specific seal of international standard, and is likely something very equivalent to FSC.[59] In addition to FCS wood, another alternative to mahogany is the Brazilian wood, Lyptus®. Reuter regularly uses this wood as a substitute, as it is a fully sustainable wood, and certainly a more cost effective option.[60]

In discussing use of sustainable woods, it is worth noting case-less organs, which requiring no wood, are perhaps even more sustainable. This style of building was made

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[57] Ibid.
[58] Interview with Didier Grassin of Noack Pipe Organs, June 18, 2014.
[59] Interview with Philipp Klais of Orgelbau Klais, August 11, 2014.
[60] "Product," Brazil's Lyptus, Accessed September 29, 2014, http://www.lyptus.com.br/produtos.php?target=o_que_eh_lyptus.

extremely popular by Walter Holtkamp, Sr. during the middle of the twentieth century. In so doing, the actual pipework was made to be the visual appeal, and the exposure of the intricacies of the instrument were believed to make the instrument easier to control.[61] Organ builders still use this today, as the stunning design by the Berghaus Pipe Organ Builders, Inc., at La Casa de Cristo Lutheran Church in Scottsdale, Arizona attests.[62] Similarly, cases built into the wall of a church, or positioned in an alcove, reduce the amount of wood needed. The instrument installed at the Interlochen Center for the Arts resides in an alcove at the front of the hall, and the Reuter company used black cloth to provide an unobtrusive backdrop for the striking façade of flamed copper pipes.[63]

Metal

The common metals used to make organ pipes remain unchanged from the organ treatises. All organ builders use pipes made varying combinations of lead and tin. The occasional use of zinc and copper was mentioned as well. In particularly, when finished with a flamed appearance, copper makes a captivating façade as seen in the Reuter organ at the Interlochen Center for the Arts.[64] Aluminum was mentioned as a possible

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[61] Matthew Bellocchio, "Time, Taste, and the Organ Case: The Influence of Architectural Styles" in *The Tracker - Journal of the Organ Historical Society* vol. 45, no. 3-4 (2001), p. 78.

[62] For more information, visit: http://www.berghausorgan.com/instr_new/lacasa/lacasa_after.html.

[63] For more information, visit: http://www.interlochen.org/facilities/Dendrinos-Chapel-and-Recital-Hall.

[64] Ibid.

alternative material to lead,[65] though its high melting point of 1,221 ^{o}F consequently requires welding, which makes alterations of pipes onsite more complicated.

An important aspect of metal pipes, as raised by one builder, concerns the thickness of the metal, depending on the material used. Structurally, because lead is a more malleable metal, lead pipes need to be quite thick in order to support the large bass pipes. Additionally, proper thickness helps prevent any unnecessary resonance of the pipe body.[66] Conversely, though, tin pipes, when made too thick, compromise "the 'tinny' effect of the metal."[67]

The organ builders interviewed strongly believed in lead's vital role in organ building. All organ builders believed that without lead, there could be no organ. This confirms the organ building treatises which suggested the use of lead is needed in order to help make tin more malleable. Monette relayed a fascinating story about a seminar at an organ building convention questioning why particularly types of metal were used. The seminar presenters included a blind listening test of various pipe metals: spotted metal, high tin, high lead, and a mystery example. While there were many good guesses as to the mystery material, no one imagined that the mystery pipe had been chopped off above the mouth and outfitted with a cardboard shipping tube. In fact, many remarked about how great it sounded!

At present, there has been no experimentation with alternative metals in order to avoid using lead in pipework. Grassin noted that European firms have moved away from

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[65] Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.
[66] Interview with John Panning of Dobson Pipe Organ Builders, September 4, 2014.
[67] Ibid.

using lead in their soldering of electronic components of the organ, but lead is still mandatory for organ pipes.[68] Presently, organ builders do not believe there is a need to move away from lead. One builder buys lead in bulk, and believes it will be 20-40 years before lead perhaps becomes a problem, citing its use in crystal glassware and use as a form of protection from X-rays as reassurance as to leads continued endurance.[69] Grassin noted, though, that builders started being more conscious of not using the word "lead" in their proposals, so as to cause any concern for the clients who might not understand the standard use of lead in organ pipes.[70]

As the treatises discussed the use of high tin, Klimus, too, confirmed the difficulty of working with high tin pipes and the high financial cost associated with using tin, though he noted that the cost of lead has increased in recent years, too.[71] Further, he mentioned that part of the fear with lead is the health risk associated with the oxidization that occurs when exposed to damp conditions. He said his employees are regularly tested, and they are always safe when working.[72] Grassin, too, in his article about the RoHS and WEEE legislation, attested that there is seemingly no record of any organ builder falling ill from lead poisoning.[73]

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[68] Correspondence with Didier Grassin of Noack Pipe Organs, September 22, 2013.
[69] Interview with Philipp Klais of Orgelbau Klais, August 11, 2014.
[70] Didier Grassin, "Controversial EU Directives: RoHS and WEEE: Was RoHS a Real Threat? …Or Just a Storm in a Teacup?" *ISO Journal: the magazine of the International Society of Organbuilders* (11, no. 27, November 2007): 76.
[71] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014.
[72] Ibid.
[73] Grassin, 76.

Alternative Materials and Recycling

When asked about using alternative materials, organ builders offered much insight. Klais aptly noted that restoration and rebuilding projects, discussed further below, can offer much insight into what materials have held up over time and what is best to avoid.[74] In this light, the general hesitancy among builders about trying more sustainable materials is understood; depending on one's perspective, these materials are not always the better option. One example is the glue used to adhere leather to the bellows. Klais noted that modern glue has ingredients that encourage the growth of mold. Consequently, they prefer using glue made by the historic method using animal skin/bones.[75]

Additionally, while synthetic leather may seem like a more sustainable option, the longevity of this material is barely five years before it dries out and cracks.[76] Using quality material lasts longer, which is sustainable in its own right. Ruffatti has specially designed their bellows so that, when the organ is off, the leather is completely enclosed, protecting it even further from the elements, and thereby extending its use.[77]

Selected builders have noted the use of non-traditional material for specific, non-speaking parts of the organ. Bill Klimus of Reuter Pipe Organs has begun using a composite acrylic polymer for their wedges, providing added stability for reed tuning, and security of the reed tongue. Panning suggested the use of otherwise cast-off lumber

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[74] Interview with Philipp Klais of Orgelbau Klais, August 11, 2014.
[75] Interview with Philipp Klais of Orgelbau Klais, August 11, 2014.
[76] Interview with Didier Grassin of Noack Pipe Organs, June 18, 2014.
[77] "Materials," Fratelli Ruffatti, Accessed October 7, 2014, http://www.ruffatti.com/Materials.htm.

of dense western red cedar plank works great for swell shades.[78] Additionally, Dobson uses carbon fiber rods for their tracker actions,[79] being a more sustainable option than even using wood. Grassin, too, noted the beneficial use of carbon fiber in pushers.[80]

Several builders commented on the practicality of melting down old metal pipe work and producing blocks for reed stops. As this is a non-speaking part of the pipe, the exact alloy of metal does not matter. Organ builders suggested that part of the difficulty with melting down metal pipes for reuse concerns the impurities that enter the metal in the melting down process. While some impurities are needed and included in the making of pipe metal, it is specifically controlled to ensure high quality production. Melting down the pipes and recasting them changes the alloy significantly, making it difficult to use for pipe metal again. However, casting blocks from this metal is a very sustainable use of material.

Many builders reuse pieces of wood in various ways. Klais takes their excess wood scraps and compresses them together to use as firewood to heat the shop in the winter. Noack sells residual pieces of maple to a local resident who uses it for smoking meat. Dobson sends wood scraps to local woodworkers, while sawdust is repurposed as animal bedding by a local farmer.

While recycling can be done for benefit of the environment, sometimes recycling is done for reasons of practicality. When an organ is shipped to its new home from the

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[78] Correspondence with John Panning of Dobson Pipe Organ Builders, September 4, 2014.

[79] "Instruments – Opus List, The Unviersity of Tampa," Dobson Pipe Organ Builders, Accessed on October 7, 2014, http://www.dobsonorgan.com/html/instruments/op89_tampa/op89_setup.html.

[80] Interview with Didier Grassin of Noack Pipe Organs, June 18, 2014.

shop, it takes a series of large crates to transport the pipework. All organ builders confirmed the reuse of their shipping materials. Panning noted that they will sell the crates to local companies at the final destination if they cannot be returned.[81] Because these crates are expensive to buy/build initially, it is more cost effective to have them shipped back to the shop to be reused, than to have to buy/build new crates each time.

Respect for Past: Restorations/Rebuilds

Paul Fritts noted that all organs, no matter how well made, will always need repairs in time.[82] The extent to which pipework is salvaged in the repair work, depends on many factors: the general condition of the old instrument, the sound quality of the pipe, the intended sound of the new organ, the sentimentality of the pipe, the necessary cost to keep an old rank of pipes, and so forth. Even electronic organ companies such as Allen Organs continue to supply parts for organs built back in the 1940s in efforts of sustainability.[83]

This first aspect, the general condition of the old organ, raises an important aspect, yet often overlooked aspect of sustainability in organ building: the quality of the original product, suggesting the length to which it can survive. Certainly the materials used are important, but investing money on something that can last for more than a one time use, is already sustainable. Paul Fritts was among the first to raise this point, though certainly all organ builders likely will agree with his words.

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[81] Correspondence with John Panning of Dobson Pipe Organs, September 4, 2014.
[82] Correspondence with Paul Fritts of Fritts and Co. Organ Builders, September 23, 2013.
[83] Correspondence with Aram Basmadjian of Allen Organs, June 16, 2014.

> This brings up what I feel is the most important aspect about our vision and that is to build organs of a high enough quality that they will not end up in a landfill somewhere. This means that the organs have both high artistic value and high quality design and construction. It is in contrast to how our throwaway system works today. No organ is completely free from maintenance and eventual restorations [are needed] as time passes. To help insure that this will come to pass rather than discarding we think a great deal about the beauty of the instruments.[84]

The long history of the organ shows much sustainability as related to the longevity of the instrument. Certainly, one of the main reasons for international study for American organists is the chance to play the historic instruments of Europe. There is much to be learned, from hearing the sounds of these instruments in person, to reveling in the power that comes from sitting at the same organ as one Johann Sebastian Bach himself played.

Grassin, too, noted early aspects of sustainability with organ building, and efforts of holding on to traditions of the past:

> I believe that organ building being such an ancient craft, it had to be "green" and recycled itself as raw material was traditionally expensive while labor was comparatively cheap. Hence, the history of organs is made of instruments being rebuilt from the remnants of the precedent … This "recycling" was done - no doubt for financial reasons. It would be interesting to see how much was also done out of respect for the past masters. Cavaillé-Coll in his 100-stops famous showpiece organ in St Sulpice in Paris did not hesitate re-using without much modifying them about 45 stops from the previous Clicquot instrument.[85]

In respecting the past, organ builders also contributed to the strong notion of "tradition" with organ building. Depending on the instrument, its importance and significance, decides whether an instrument is retained in part or in total. If parts of an instrument are saved, it is considered a " rebuilt" or repurposed instrument, incorporating some of the

[84] Correspondence with Paul Fritts of Fritts and Co. Organ Builders, September 23, 2013.
[85] Correspondence with Didier Grassin of Noack Pipe Organs, September 22, 2013.

best parts of the old instrument into the new one. However, some instruments are cherished treasures, in which case a full restoration is more likely.

Panning aptly noted that in a restoration the goal is to salvage as much as possible of the original instrument.[86] One such company who excels at this work is Fratelli Ruffatti, where they believe nothing cannot be restored: "We take the utmost care in restoring the original shape of even the most damaged pipes, resoldering them where broken, while respecting at much as possible their original parameters."[87] With the vast number of historic instruments in Italy, there is always work to be done regarding to restoration work. As discussed above, great importance is placed on instruments of historical significance, and so restorations of these instruments really aim to bring them back to their original sound.

Ruffatti includes wonderful pictures on their websites showing the work they do to restore pipes and keyboards, using the maximum amount of original material, and only the bare minimum of new material. If, in fact, something cannot be saved, they will return to the materials available at that time, including the building practices, in order to recreate it as authentically as possible. Pictures on the Ruffatti website shows detailed pictures of a keyboard and corroded pipe before and after restoration. The differentiation in coloration of the restored keyboard and pipe shows the old and new material.[88]

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[86] Correspondence with John Panning of Dobson Pipe Organs, September 4, 2014.
[87] "Historical Restorations" Fratelli Ruffatti, Accessed on September 23, 2013. http://www.ruffatti.com/historical_restoration.htm.
[88] Ibid.

Ruffatti also ensures that the wood is properly protected so it will last for centuries to come. Some deterioration of the wood is caused by insect infestation, so in order to counter this, a complicated process ensues:

> The wooden parts of the entire instrument are placed inside a thermo-sealed plastic envelope, from which all air is extracted. Nitrogen is then introduced in its place, and the residual oxygen content, at a level of less than one per cent, is monitored by a computer. The wood is kept inside this envelope for one month, at constant temperature. After all of this is done, the wood is further treated with an innovative liquid which is non-toxic to humans but will make the wood poisonous to parasites. This liquid has the same effect on wood as water, neither altering nor coloring its fibers.[89]

While this may seem an exorbitant amount of work, it reflects Panning's opinion that the main goal of a restoration project is to save as much of the original instrument as possible. Just as certain family heirlooms are worth their price many times over in order to keep them for generations to come, so, too, some organs are worth this level of intensity, preserving it to allow future generations of organists a glimpse into the sound and style of the past.

One often easily salvageable piece in an organ is the screws used in the organ. Monette explained that modern screws are stamped in, causing them to tear up the wood when inserted.[90] Older screws have a higher rate of consistency among them as they were all steel spun and cut in. Consequently, when coming across old parts of an organ no longer salvageable for one reason or another, the screws are often saved, being of high quality and easily reusable.

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[89] Ibid.

[90] Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.

One difficulty in reusing old parts of the organ concerns the specificity to which each organ is constructed, as described by Grassin. Organs are tailor made to the space in which they live. If additional stops are added in the rebuild, this inevitably changes the arrangement of the pipework. Further, being of considerable size, putting an organ in a new home means it may not fit exactly as it could in its previous space, whether too tall, wide, or shallow. As the organ parts cut to specifically fit the space, these tiny pieces cannot be easily adapted to fit a new space.[91]

Organ builders discussed the tonal properties of old pipe work and the complications of adapting it to their new organ. Klimus nicely summarized it into three categories. If a pipe sounds good, it can be reused. If it has a unique sound and is well-preserved, it is also good to reuse. If the pipe doesn't sound good, but they think it could, then it, too can be reused. Ultimately it seemed to depend on the amount of irreversible damage done to the pipe, such as whether the amount of nicking or the height of the cut up. There are some alterations for voicing which cannot easily be undone.[92] Panning likewise credited the sentimentality of the pipe as a reason for it to be salvaged, whether it comes from a previous rebuild, or if it was perhaps specifically donated by a member of the church and therefore needs to remain in the future instrument.[93]

The ultimate decision depends on the needs of the client in relation to the overall tonal design of a particular company. Should the pipe have a particular sound that goes against the style of the new organ being rebuilt, it makes it difficult to save this pipe. In

[91] Correspondence with Didier Grassin of Noack Pipe Organs, September 22, 2013.
[92] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014.
[93] Correspondence with John Panning of Dobson Pipe Organs, September 4, 2014.

such cases then, the future of this pipe varies. Instead, builders note its use is better served by being melted down and used for a reed block, as discussed above, or simply sent out to be recycled.

Wood pipes have an easier time being repurposed. The amount of clean wood required by large bass pipes makes them particularly easy to be reused. The low pipes lack much character, ultimately, so it is easy for them to be reincorporated. A 32' pipe has a limited amount of speech; its power is felt more than heard by the listener. Additionally, as the expense of building these pipes is significant, it saves considerable time, money, and resources to reuse these pipes. However, should the pipe not be usable as an entire rank for one reason or another, Grassin noted their excellent use as trackers for a new organ, because of the length and cleanliness of the wood with these large bass pipes.

Finances

Organ builders cited cost as another deterrent in salvaging metal pipe work. While some pipes can be saved, as outlined above, pipework that has been altered too severely is discarded. When asked about the possibility of melting down this old pipework, separating out the metals, and then reusing the raw material to engineer new pipes, organ builders were uninterested. Instead, all organ builders noted sending the unusable pipes to metal recyclers to be discarded properly. As discussed above, several mentioned using melting down this pipe work to make reed blocks instead.

Finances also make it more complicated to save organs to be reused, as described

by Dyer.[94] The Organ Clearing House is known for its large collection of organs being offered a second chance.[95] Often these instruments have been taken out of a church in their entirety, rather than having parts reused by an organ builder. However, storing these instruments costs money, and being unsure of when it might be used again, it is perhaps not the best use of resources.[96]

Reusing the large wooden bass pipes is beneficial financially for builders. Builders were quick to note the number of full-length 16' and 32' pipes can dramatically change the cost of an organ. While materials in general cost anywhere from 10-35% of the total price for the instrument, the number of large bass pipes in particular changes this cost, as noted by Monette.[97] Panning noted that while they offer a FSC option for their wood pipes, most clients have either been uninterested or unwilling to pay the added expense for this more sustainable option.[98]

On a final note regarding the financial aspect, Klimus commented that, compared to the amount of wood required for an organ case or large wood pipes, the amount of wood used in an organ console is relatively small. Consequently, spending a bit more money on nicer woods for the sake of appearance and stability is merited.[99]

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[94] Correspondence with Randall Dyer of Dyer Organs, September 22, 2013.
[95] "Instruments," Organ Clearing House, Accessed October 3, 2014, http://www.organclearinghouse.net/index.php?content=instruments&list=avail.
[96] Correspondence with Randall Dyer of Dyer Organs, September 22, 2013.
[97] Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.
[98] Correspondence with John Panning of Dobson Pipe Organs, September 23, 2013.
[99] Interview with Bill Klimus of Reuter Pipe Organ Builders, July 14, 2014.

Expanded Ideas of Sustainability

The original focus of this study concerned mostly the materials used in organ building, possible alternatives, and the recycle and reuse of materials. However, in conversations with organ builders, several trends emerged regarding other sustainable aspects to organ building.

One of the more fascinating concepts of great concern commented on by one organ builders is the sustainability of their employees.[100] By knowing the inner dynamics of the company, from voicing techniques to the specialized talk of a given shop, organ builders consider their employees invaluable to their product. This has been true throughout history, when one considers the G. Donald Harrison years at Aeolian-Skinner or the Gerhard Brunzema years at Casavant. These were periods of a company specifically delineated by those who worked there. The employee creates the organ, more than the mere company name. Maintaining these relationships sustains the quality and tradition cultivated by a company, as the long tenure of most employees attests.

Two organ builders advocated for the importance of sustaining the working relationship developed with their suppliers.[101] While some organ shops build and manufacture all aspects of the organ, other shops receive metal pipe work from an organ supply company such as Laukhuff in Germany, or Organ Supply Industries in Pennsylvania. As the working relationship has been developed over several years, continuing the relationship saves time and minimizes room for error. Organ companies

[100] Ibid.

[101] Correspondence with Didier Grassin of Noack Pipe Organs, September 22, 2013. and Interview with Kelly Monette of Berghaus Pipe Organ Builders, August 19, 2014.

learn how to articulate what they want, and over time, the supply company needs less information from an organ builder, as they learn the specifics of each company.

Most organ builders articulated their regular use of high efficiency light bulbs to light the music rack. The benefit for this is due to the low heat produced and the high brightness provided.[102] Additionally, as much of the console is made of wood, the low heat produced is particularly important; it happens to be an added bonus that it is more environmentally friendly.

Most importantly, all organ builders also made efforts toward increased sustainability in their shops. Panning cited their use high efficiency lighting, and programmable thermostats and ceiling fans to minimize energy consumption.[103] Fritts is likewise concerned with their carbon footprint in the Northwest, and uses a geothermal heat pump system to heat the workshop. This system replaced a boiler system which consumed more than 2,000 gallons of fuel oil per year. An added perk is the financial benefit received, as this new system costs about one seventh of what the oil did.[104] Other builders, too, echoed these ideas with their own efforts in recycling and high efficiency lighting within the shop.

Additional Recommendations

In considering all aspects about the organ, another area of potential sustainability concern is the electricity consumed by the organs. Some organs, in efforts of historical

[102] Interview with Didier Grassin of Noack Pipe Organs, June 18, 2014.
[103] Correspondence with John Panning of Dobson Pipe Organs, September 4, 2014.
[104] Correspondence with Paul Fritts of Fritts Organ Builders, September 23, 2013.

authenticity, have the option to hand pump the organ. As this was the traditional method of supplying wind to the organ, it can be used on modern organs to provide the added flexible winding more appropriate to specific earlier styles. Additionally, this saves a bit of electricity by physically providing the wind, as opposed to constant winding from the turbine. Similarly, being conscious of the amount of lights turned on in the church or organ hall when practicing, saving the brighter lighting for service or concerts.

Further sustainability aspects focus on logistics within a church setting. As church communities become more aware of their own carbon footprints, they may force organ builders to consider more thoughtfully the sustainability of the instruments they make. Already, many churches use screens for projecting lyrics and congregational responses, which allows for last-minute changes, as well as for reduced paper consumption in printing bulletins. Perhaps the pervasiveness of electronic devices will soon offer congregants the option of downloading digital copies of the bulletin rather than using a paper version. Again, this would allow for changes to the musical program without reprinting bulletins. As congregations work to "go green" and protect the environment, they will naturally want to insure that new organs include sustainable aspects of construction. Such a shift in consumer demand will lead to quicker changes in the resources used by organ builders.

Even within a music department at a church, some solutions seem simple enough, if one chooses to be cognizant of them. Copying a page for ease in a page turn is understandable, but perhaps photocopying an entire piece is unnecessary. Although most organists rely on the tactile sensation of a printed score, perhaps using an electronic tablet

for visual display of music score for a simple anthem or accompaniment is a small step toward requiring one less photocopy of a piece.

Another possibility, regarding worship bulletins with descants and hymns for the choir, suggests saving these descants for use again later, rather than just that one morning. Maybe one uses higher quality and sturdier paper, such as cardstock, initially. This way, the continued use by the choir for years to come, enduring the wear and tear from being moved in and out of their binder, will survive a bit longer.

CHAPTER 5

SUSTAINABILITY IN ORGAN BUILDING: FUTURE POSSIBILITIES

The purposes of this study were devised to examine the effectiveness of various types of alternative resources in organ building, determine the reason for using current materials (e.g. lead, walnut, etc.), examine whether a change to more sustainable materials would cause a benefit or hindrance in the overall sound production, analyze the financial costs of using more sustainable materials within the context of the overall cost of an organ project, and ultimately recommend possible alternatives to make the organ more "green."

Interviews were held via telephone, Skype, or through email correspondence with four US-based and one European-based organ builders. Interview questions focused on selection of materials for pipes, wind chests, organ cases and organ consoles; importance of materials used in overall organ performance; financial considerations in organ building; and use of sustainable materials and practices. In addition, the websites of nine national and five international organ builders were reviewed, with some particularly insightful information.

Results indicated a multitude of options regarding woods, though poplar was most common. Beneficial woods include those that have been properly seasoned and less susceptible to the elements. Stronger woods and more exotic woods work best for the organ console because of the stability required and the visual focus of the console. European companies use renewable and certified wood as standard material. Certified woods are not regularly used in the US, though the use of local North American woods is perhaps environmentally friendly in itself. Tin and lead continue to be used most often

for metal pipework, despite the threats of RoHS and WEEE to prohibit the use of lead in organ building.

In conclusion, sustainability practices among organ builders were found to vary greatly. The initial quality of the instrument and the frequency with which organs are rebuilt and parts reused are sustainable practices intrinsic in the instrument. In efforts of recycling, builders commonly reuse of large wood bass pipes and melt discarded metal pipework down to make reed blocks. Organ builders also noted the importance of sustaining working relationships with their employees and suppliers.

But, what does sustainability really mean for the organ? What are obligations toward saving resources? Grassin rightly acknowledged that the organ building trade is so small, it probably does not matter much on a global scale.[105] And, perhaps not. But, there is the common question and idea of "what difference can I make? I am just one person." Perhaps it is why, as a nation, we are slow to accept the changes of sustainability. As an individualism-centered society, there is focus on how something benefits "me," and an idea that one person cannot effect change. When the focus changes to, "what can I do to make a difference," then everyone's efforts can combine to make substantial change.

Grassin, too, in discussing the RoHS and WEEE legislations that could have changed the entire face of organ building states: "It might also be appropriate nowadays to be more environmentally aware. If this is not out of personal belief, it should be done at least for the sake of keeping under the environmental radar. The cleaner organ building appears, the less legislators will be inclined to impose regulations."[106] Organ builders are

[105] Interview with Didier Grassin of Noack Pipe Organs, June 18, 2014.
[106] Grassin, 74.

more concerned with the environment, perhaps having heeding Grassin's warning written in 2007.

Unfortunately, fear may be the largest preventative force with trying alternate materials in the organ building business. Organ builders interviewed discussed the difficulty with contracts at the moment. While interest was expressed in finding alternatives in building, there is hesitation in making sure the testing of a new idea, does not become a nightmare for the company or client in a matter of years. As was found with synthetic glue and leather, there is fear in trying something new, especially considering the money invested to try it initially, with no guarantee as to its success. The incongruity of the possibility for new and better ideas, combined with the fear of failure and loss of anything from money and time, even up to a company's reputation, stifles creative use of materials even when there are some areas of interest for one to consider.

Schlick argued for the continued advancement of the organ even as of 1511: "An organ builder should occasionally develop new ideas of his own, should constantly evolve new approaches and test out his inventions so that this most laudable art be perpetuated, exalted, and advanced to the praise of God."[107] Sustainability efforts may well be the next evolution for organ building. While progress has already been made in this direction, hopefully discussing these ideas will imbue, incite, and inspire organ builders to create change that benefits not only the environment, but also the great "King of Instruments"!

[107] Schlick, 51.

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Fritts and Company Organ Builders, http://www.frittsorgan.com/

The Holtkamp Organ Company, http://www.holtkamporgan.com/

Noack Organ Company, http://www.noackorgan.com/

The Reuter Organ Company, http://www.reuterorgan.com/

Electronic Organs:

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International Organ Builders:

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Orgelbau Klais Bonn, http://www.orgelbau-klais.com/

Pipe Organ Builders Fratelli Ruffatti, http://www.ruffatti.com/

APPENDIX A

RECRUITMENT SCRIPT

Dear _____,

My name is Jonathan Gregoire, and I am a graduate student in the School of Music at Arizona State University studying organ under the direction of Professor Kimberly Marshall. Presently, I am conducting a research study regarding ways organ building might become more sustainable, through both resources used and energy consumed.

I am recruiting highly skilled and internationally respected organ builders to offer their insight, expertise, and guidance regarding the feasibility of such practices. Should you be willing to participate, I would enjoy interviewing you this summer at the American Guild of Organists Convention in Boston, or by phone/Skype. I have attached a series of interview questions that will help direct our conversation. The interview will be 30-60 minutes in duration, and there may be additional follow up. I would like to audio record the interview.

Your participation in this study is completely voluntary. I have likewise attached a consent form and interview questions for your perusal. If you have any questions concerning the research study, please don't hesitate to call me at (320) 333-8894. I look forward to hearing from you.

Regards,
Jonathan

APPENDIX B

INTERVIEW GUIDE WITH ORGAN BUILDERS

Regarding Materials:

1) What are the materials you regularly use for the following:
    a. Wood pipes:
    b. Metal pipes:
    c. Wind Chests:
    d. Organ Cases:
    e. Organ Consoles:
2) Of the materials listed about, how important are these specific materials to the overall effectiveness of the organ?
    a. Wood pipes:
    b. Metal pipes:
    c. Wind Chests:
    d. Organ Cases:
    e. Organ Consoles:
3) Are there tonal benefits to using specific types of woods or metals?
4) What is the purpose specifically of lead?
5) From where do you receive your materials?
6) Have you noticed a shortage of specific types of woods?
7) Do you regularly paint organ cases, or would you consider this?

Financial Considerations:

1) What percentage of the total instrument cost currently entails expenses for materials? What is an average instrument size/cost for you?
2) How much more does using FSC wood cost as opposed to the wood generally used?
3) How much would it cost to re-use old metal organ pipes if one needed to first melt them down, separate the alloys, and re-issue metals?

Restorations:

1) How much material do you salvage in a restoration project?
2) What decides whether you keep or discard a rank of pipes?
3) What are the logistics of melting and recasting metal pipes?
4) Are old pipes capable of being re-voiced to fit your tonal sound?

Practical Considerations

1) Would you consider using alternative resources such as composite materials?
2) What is your interest level in exploring alternatives in organ building?
3) Would you be interested in building a few pipes out of composite material to test its sound production in relation to the other pipes you build?
4) When you ship an instrument to a site, do you save the shipping materials to be reused again?
5) What efforts do you make in your organ shop toward sustainability? Water? Electricity? Lighting? Recycling of materials?

APPENDIX C

CONSENT FORM

Title of research study: Toward a "Green" Organ: Organ Building and Sustainability

Investigator: Jonathan M. Gregoire, D.M.A. Student at Arizona State University, USA

Why am I being invited to take part in a research study?

I invite you to take part in a research study because you are an internationally well-respected organ building company. I believe your insight into organ building will be invaluable to this study.

Why is this research being done?

Little has been written about sustainability work in organ building. I am interested in learning more about sustainable practices and materials being used by organ builders.

How long will the research last?

I expect that we will spend about 30 to 60 minutes discussing your organ building practices. The attached interview guide provides a sense of the types of questions I would like to discuss with you. I may follow up with you during July and August for additional elaboration on your responses to the interview questions, which will take 30 minutes.

How many people will be studied?

I expect about 5-10 national and international organ builders will participate in this research study.

What happens if I say yes, I want to be in this research?

You are free to decide whether you wish to participate in this study. However, your knowledge and insight about organ building will be invaluable to my dissertation about sustainability and organ building, as there is no current research available. I will be recording our interviews so that I can focus on our conversation and still have authentic record of what was discussed.

What happens if I say yes, but I change my mind later?

You can leave the research at any time it will not be held against you.

Is there any way being in this study could be bad for me?

There are no foreseeable risk to participating in this study.

Will being in this study help me in any way?

I cannot promise any benefits to you or others from your taking part in this research. However, I will provide a summary of the information I gather in my interviews to each of the participants. You might benefit from learning what sustainable practices are being used successfully by other organ builders.

What happens to the information collected for the research?

The information gathered in this research will be included in my doctoral dissertation and hopefully published in literature for the organ community. Your company name and the sustainable practices used by your company will be directly identifiable in possible publications, reports, and/or presentations, so that others may be made aware of your work.

Who can I talk to?

If you have questions, concerns, or complaints, you may talk with the Principal Investigator of this project, Dr. Kimberly Marshall at Kimberly.Marshall@asu.edu

This research has been reviewed and approved by the Social Behavioral IRB. You may talk to them at (480) 965-6788 or by email at research.integrity@asu.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

By taking part in this interview you are consenting to take part in this study.

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Signature of participant	Date
Printed name of participant	
Signature of person obtaining consent	Date
Printed name of person obtaining consent	

APPENDIX D

IRB EXEMPTION STATUS

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Kimberly Marshall
Music, School of
480/965-1227
Kimberly.Marshall@asu.edu

Dear Kimberly Marshall:

On 6/11/2014 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Toward a "Green" Organ: Organ Building and Sustainability
Investigator:	Kimberly Marshall
IRB ID:	STUDY00000898
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• JMGregoire Organ Builder Consent Form FINAL.pdf, Category: Consent Form; • Gregoire HRP-503a Social Behavioral Form FINAL.docx, Category: IRB Protocol; • JMGregoire CITI Training Compeletion Reports.pdf, Category: Other (to reflect anything not captured above); • Organ Builder Recruitment Script FINAL.pdf, Category: Recruitment Materials; • Interview Guide for Organ Builders.pdf, Category: Recruitment Materials;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 6/11/2014.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Jonathan Gregoire
Jonathan Gregoire