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RETRACING OLD ORGAN SOUND. AUTHENTICITY AND THE STRUCTURE OF ARTISTIC ARGUMENTS

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The Organ as an Artistic Technology

Until well into the twentieth century, the sound of church organs would start with the movements of a bellows treader. An organist who wanted to play would sound a small bellows bell to signal the treader that he should fill the organ's bellows with air by standing on large wooden beams. Pressing down the beams by the weight of his body opened the wedge formed bellows, and air would start to flow from the bellows into the wind channel system of the organ. This system leads the pressurized air, or 'wind', as organ players say, to the wind chests. The actual organ sound is produced when air flows from a wind chest through an organ pipe. Pipes are grouped in so-called stops that share a sound color. The difference in sound colors results from the shape, length, width, material and type of organ pipe. A big organ from the late seventeenth century would normally have up to forty different stops, all consisting of as many pipes as the organ had keys on the keyboard. Each of the stops has its own name, such as Principal 16´, Octav 8´, Blockfloit 4´ or Gemshorn 2´. The numbers indicate the length of the pipe in feet, which determines the pitch of the sound. An organ has at least one wind chest, but usually two or more. Each wind chest has its own keyboard or manual, and bigger organs also have a pedal board that is played by foot. Inside the wind chest, sliders pulled by the organist open or close the ranks of pipes that stand on it. The movement of pressing a key is mechanically led through the organ from the keyboard to the wind chest, where it opens a valve. As a result, the wind flows into all the pipes for which the stops have been pulled, thus producing a sound.

Following the journey of the wind from the bellows through the wind channels and the wind chests, to the pipe mouths, is a way to visualize the basic anatomy of a church organ. This anatomy characterizes the oldest preserved instruments, some of which have been built in the fifteenth century, as well as the newest. Old organs that have survived till the present day are often changed in many ways. Pipes have been removed, renewed, or retuned. The bellows, that used to be trodden by foot, were replaced by an electric wind device. The mechanical action of the keyboard, the stops, and the sliders in the wind chests were changed. New pipes and parts were added. As a result, these age old instruments can be considered as coral reefs, containing the material and artistic sediments of ages. They are vehicles of information about how the instruments were designed and built, how they were meant to sound, and how they were part of musical practices, both secular and religious.[1] As Snyder (2002a:1) puts it, the organ is both an historical and an aesthetic mirror that 'has stories to tell about the times in which they were built that go far beyond the music that was played on them'.

The continuing process of restoring and rebuilding old organs offers an interesting field of research. Conserving these instruments not only has the goal of preserving them as silent historical artifacts, but also to recreate their original sound according to the latest scientific and aesthetic insights. As sounding instruments, they are intended to remain part of a living musical culture. The topic of this article is the historical and applied research that is necessary to recreate the sound of Northern European organs from the 17th and 18th centuries. My aim is not to provide an extensive historical or organological account of organ restoration. Not only is this beyond the scope of this article, it would require expert knowledge in a variety of fields. Rather, as an STS scholar I am interested in the different ways these experts argue for the claim that they are able to recreate the organ sound of the past.

There are at least two reasons why studying the organ would be interesting from an STS point of view. First, as Pinch and Bijsterveld (2004: 638) have convincingly argued, 'musical instruments can be thought of as technological artefacts'. Considering the organ as a *technology* opens the possibility to study its anatomy in relation to the people who created and used it, to the landscapes, both geographical and social, that housed them for centuries, and to the traditions and ideals that shaped them over the years. In general, studying the organ in terms of its co-production by different users, as well as its design and (re)building as an amalgam of social, cultural and economic factors can thus tell us much about music as a form of culture (see also Pinch & Trocco, 2002). Second, studying the collaborative work of the scientists, organ designers, builders and musicians involved in the search for old organ sound also enables us to ask questions that follow from the fact that an organ can be considered as an *artistic* technology, i.e. as a special kind of technology that is meant to produce aesthetic experiences.[2] How are notions of 'authenticity' renegotiated in the process of restoring an existing organ or building a copy of a historic organ? How is the claim that these organs produce old sound backed up, both by scientific and artistic arguments? How are these styles of reasoning – scientific and artistic – shaped in the relearning of old practices, e.g. the casting of organ pipe metals, as well as the use of modern technologies such as computer simulation and model experiments?

In order to answer these questions, I first relate the concept of 'authenticity' to the historical performance practice of music, and what could be called the historical restoration practice of musical instruments. I then present two case studies. The first case study describes the restoration of an organ that was built in 1780 by the Dutch organ builder A.A. Hinsz in the Catharina church in the village of Roden, close to the city of Groningen. The second case study focuses on the North German Organ Research Project in Göteborg, which had as its goal not the reconstruction of a particular *organ* as in Roden, 'but a particular organ *sound:* that of a large organ for a Hanseatic city in the style of Arp Schnitger, tuned in pure quarter-comma mean tone' (Snyder, 2002b: 342). In my concluding discussion, I will argue that the organ restorers, when trying to recreate the actual sound of the past, are in fact constructing an argument in which the claim takes the material form of a musical instrument. To back up this 'material claim', they mobilize relevant contexts as evidence. These contexts can be scientific knowledge of historical performance and build-ing practices, or the artistic skills of tuning organ pipes and intonating the instrument. When answering the normative questions that are at stake in choosing between 'good' and 'bad' restorations, we should first study the various strategies that organ researchers actually follow to make sure their contexts are accepted as relevant to their 'material claim'.

Musicians as Researchers

In 1952, the German composer Paul Hindemith wrote about authenticity in musical performance of early music:

'All the traits that made the music of the past lovable to its contemporary performers and listeners were inextricably associated with the kind of sound then known and appreciated. If we replace this sound by the sounds typical of our modern instruments and their treatment, we are counterfeiting the musical message the original sound was supposed to transmit. Consequently, all music ought to be performed with the means of production that were in use when the composer gave it to his contemporaries.' (Hindemith, P. (1952), cited in Lawson and Stowell, 1999: 10-11)

The normative performance ideal that Hindemith formulated in 1952 was not universally accepted. On the contrary. Music from the baroque and classical eras by composers such as Bach, Mozart and Beethoven was played on modern instruments, often by large orchestras and ensembles that produced a correspondingly large sound.[3]

From the 1960s onwards, more and more musicians took sides with Hindemith in the debate on the performance of early music. They started

to do research that was meant to recreate the original sound of renaissance and baroque music. Pioneering musicians like Nikolaus Harnoncourt, Gustav Leonhardt and Frans Brüggen played on restored original instruments or replicas, they played from critical edition texts and they adjusted the size of choirs, orchestras and ensembles to historical conventions. Musicians became researchers who studied autographs, sketches, and drafts of a composition. They based their interpretations on primary source materials ranging from instrumental and theoretical treatises to surviving instruments, iconography, historical archives, references in literature, journals, newspaper reports, sometimes letters, diaries, catalogues, advertisements, and for the post 1900 music, even recordings (Lawson and Stowell, 1999: 17-41). Critics of the early music movement argued that this scientific strategy resulted in performances that focused on mere sound and completely lacked the living, expressive qualities of the music.[4]

Since the days of pioneering recordings of the works of Monteverdi and Bach by Harnoncourt and Leonhardt, baroque and classical repertory has become the domain of specialised conductors, musicians, ensembles and orchestras. European early music, which nowadays includes music as recent as from the 1920s, has been reinterpreted and recorded in a wide variety of historically informed performances and become an essential part of modern music culture. This development would have been impossible without the flourishing development in instrument building and restoration, making it possible for musicians to play string, wind, and keyboard instruments from different time periods. Surviving instruments were used to study and experiment with matters of technique, style, and interpretation. Instrument builders took these old instrument as a starting point to relearn old practices of instrument building. Again, this research was not just organological in character, but was part of an animated debate on what was called 'historically informed / inspired performance practice (HIP)' (Lawson and Stowell, 1999; Haynes, 2007).

The restoration and rebuilding of old church organs was closely related to the reinterpretation of early music by musician-researchers and the corresponding development of instrument building (Fidom, 2000). However, organs present a special case. They are large and expensive instruments, that were not simply replaced, but more or less continually extended and restored in different periods. In the 19th and early 20th centuries this often meant that large parts of the organ were removed, replaced, or that new elements were added. Old organs thus reflect the influence of ages. Traces of the original have been kept, but often in a changed state. A conference in Groningen in 1969 to commemorate the North German organ builder Arp Schnitger (1948-1719), who built many organs in the northern provinces of the Netherlands and Germany, marked the start of a lively discussion on what could be called 'historically informed organ restoration' (Davidsson, 2000). Existing organs should not be restored to the match the technical and artistic criteria of today, but rather brought back as much as possible to the state they were in when they were first built. The restoration of organs should be based on scientific research into the original disposition of the organ.[5]

Interlude on Authenticity and Music

The scientific goal of restoring organs to their original state is closely related to the artistic ideal to recreate its original sound. This combination of descriptive and normative intentions is expressed in the concept of ' authenticity' that has been central to the debate on the performance of early music.[6] According to the analytic philosopher Peter Kivy (1995), we can distinguish between at least four ways to link the notion of authenticity in a meaningful way to musical performance practice. These are '(1) faithfulness to the composer's performance intentions; (2) faithfulness to the performance practice of the composer's lifetime; (3) faithfulness to the sound of a performance during the composer's lifetime; and (4) faithfulness to the performer's own self, not derivative of or an aping of someone else's way of playing' (Kivy, 1995: 7). Kivy then distinguishes between the practical question if these forms of authenticity are possible, and the normative question whether they are desirable. After he refuted the possibility of the first three forms, Kivy argues for a fourth kind of 'authenticity' based on the individual style and originality of the performer. Where there is no such thing as 'authenticity' in the singular,

he welcomes 'any mix of authenticities, that withstands the only relevant test there is: the test of listening' (1995: 285).

Kivy is not alone in his conclusion that the concept of 'authenticity' in music represents an *ideal* to be aimed at, rather than an attempt to reproduce the *actual* past performance. To develop this point, Davies (2002) draws a contrast between performing and copying. Whereas copying could be done in a mechanical process, performing always involves the personal creativity of the performer. 'Performing must go beyond that which is given in order to present accurately what is given. But nothing not present in the original needs to be brought to copying'(2002: 66-67). James O. Young (2002) takes a very different view, arguing that the concept of authentic performance is not a useful one. Because each age must interpret Bach for itself, there cannot be an 'authentic' and ideal performance of a composition but, rather, many. If the early music movement has enriched musical experience, he argues, it is not by giving authentic performances, but by giving successful ones. '[An early music performance] is valuable not because it bears some relation to past performances, but because present listeners find it artistically appealing'(2002: 77).

The American musicologist Richard Taruskin was one the first to defend the position that 'authenticity' in musical performance has little to do with being faithful to anything that happened in the past, be it the composer's intentions, the actual sounds, or the practices of music making. In his essay 'The Pastness of the Presence and the Presence of the Past' (1988, reprinted in Taruskin, 1995), he wrote:

'I am convinced that "historical" performance today is not really historical; that a thin veneer of historicism clothes a performance style that is completely of our own time, and it is in fact the most modern style around; and that the historical hardware has won its wide acceptance and above all its commercial viability precisely by virtue of its novelty, not its antiquity.' (Taruskin, 1995: 102)

By describing the 'authentic' music movement as a profoundly modern approach to early music, Taruskin acknowledges the fact that any musical performance is historical in the sense that the present always actively participates. 'The pastness of the presence is as much implied by it as the presence of the past' (Taruskin, 1995: 106).

This discussion of 'authenticity' is relevant for the topic of this paper. In the act of restoring organs, as in the performance of early music, the past is not only represented as a material reality, but also as an ideal. This underlines the ambiguity of the historical and applied research that is necessary to recreate the sound of Northern European organs from the 17th and 18th centuries. The primary goal of this research is not to answer the question 'how it really was'.[7] Rather, as I will argue, it focuses on rendering relevant contexts that can be used as evidence in what is both a scientific and an artistic claim: the restoration of the sound of 1780 *in its present beauty*. As I will show in my first case study, backing up this claim implies that a 'passage' is built that links the past to the present in a convincing way, both scientifically and artistically.

Roden: Reconstructing 'Breathing Wind'

In 1780, the organ builder A.A. Hinsz completed an organ in the Catharina church in the small village of Roden, in the northern Dutch province Drenthe. The economy of the poor rural community was based on agriculture, and the organ was paid for by a wealthy lady who lived in a nearby borough, called 'De Mensinghe'. Hinsz originally came from Hamburg in North Germany, where he was influenced by the great organ builder Arp Schnitger. In 1728, he moved to Groningen and he became one of the most sought-after organ builders of his time. After it had installed the Hinsz organ, Roden became part of what could be called the 'organ geography' of Groningen.[8] The Hinsz organ came with two keyboards, a pedal board, a disposition consisting of 17 stops, and some playing aids, such as the possibility to couple the manuals (Tuinstra, 2006a).

After the organ had been revised in the nineteenth century and renovated in the 1930's and 1950's of the last century, it was recently restored in 2005.[9]

What made this restoration interesting from an organological point of view, was that the instrument still contained many of the original pipes, and most of these were still in their original state. The organ, however, had been retuned in the past. The aim of the restoration project was to bring back the original pitch, sound, and intonation in the organ, to restore the original wind channel system, including manually operated wind bellows, and to revise the existing internal parts of the organ such as the organ pipes and the transmission mechanics from the manual to the wind chest.

The restoration was done in close cooperation between a scientific adviser, an organ builder and the church organist.[10] They based their decisions on extensive study of other Hinsz organs in the region, on the archival sources about the building of the organ, on their practical experience as organ scholars, builders and musicians, and on a continuing artistic dialogue on the preferred character of the organ sound. After the restoration the scientific adviser claimed that for many stops the sound we now hear is more or less exactly the same as it was heard by the members of the congregation in 1788 when the organ was first played:

'I think we can say with a certainty of 95 or 97 percent that we hear the authentic sound of 1780. [He plays a chord]. So now you actually listen to a time machine. We are able to determine with a reasonable amount of objectivity that we are that close to the truth.' (Interview with the scientific adviser to the Hinsz organ restoration, Roden)

To understand how this claim has been backed up in the actual restoration process, I focus on two aspects: the tuning of the pipes, and the reconstruction of the wind system.

As in almost every large church organ, the Hinsz organ has two pipe families: flue pipes and reed pipes.[11] The actual sound of a pipe is the result of an intricate process of tuning. In the case of flue pipes, the pitch is regulated by shortening or extending the pipe. Reed pipes are tuned by adjusting the position of the reed in the wooden base of the pipe. Apart from the pitch, the actual sound character of a pipe results from the interplay between the tone and the sound of escaping air. This can be compared to the difference between consonants and vowels in the human. An organ pipe makes a hissing sound when the key is pressed, then the tone follows. In the case of flue pipes, this hissing sound is the result of the make up of the relative measurements and distances of the lower lip and the upper lip that form the mouth opening, the relative position of the lower lip, the wind pressure, etc. According to the scientific adviser:

'one can go on adjusting and tuning the pipes until they all sound more or less the same, but then you have something that sounds like the sine tones of an electronic organ. For every pipe we had to make a decision whether where to stop perfecting the individual tone in relation to the others.' (Interview with scientific adviser).

The actual tone and sound that a pipe produces depends not only on the physical characteristics of the pipe, but also on the wind pressure and the speed with which the air passes though the pipe. The dimensions of the wind system, i.e. the sizes of the bellows, the wind channels and the wind chests, are calculated to provide enough air when all the stops are drawn and all the pipes sound. When there is not enough wind for all the pipes to produce a proper sound, the organ is called 'windziek' (wind ill). Sometimes this effect was creatively used by organ builders, as was the case in Roden. The original dimensions of the wind system of the Hinsz organ were a bit too tight. This caused irregularities in the flow of air in the wind channels and wind chests. This in turn had the effect of creating a slightly vibrating effect in the tone, that can be compared to a singing human voice and is called 'breathing wind' (Tuinstra, 2006b). The effect is intensified when the bellows are trod by foot because, according to the scientific adviser, this creates a more variable and therefore natural wind flow through the system.[12]

In the nineteenth and twentieth centuries, the dimensions of the wind system were enlarged, because the musical preferences of the time decreed that the effect of 'breathing wind' was experienced as a disadvantage. The organ restoration team in Roden decided to bring back the original dimensions of the wind system and to build three new wedge bellows that

could be trod by foot (Boerema, 2006). This reintroduced the 'breathing wind' in the organ and thus gave it its original tone quality:

'The "breathing wind" gives the old organ sound a certain suppleness and tunefulness, that makes it more lively and less stiff. A correct dimensioning of the wind system renders a balanced tone and gives us a very artistic means of expression.' (Interview scientific adviser).

The tuning of the pipes and the restoration of the wind system in the Hinsz organ in Roden are exemplary for the way in which the team tried to build a convincing argument for the claim that the sound it now produces is the sound of 1780. This argument consists of heterogeneous elements: the original material still present in the organ; written sources like the test report from 1780; the knowledge of the original organ-geography, i.e. the local knowledge, practices, habits, measurings, and musical routines that can be deduced from similar organs in the North of Holland. It also consists of the intersubjective artistic judgements that result from the dialogue between the scientific adviser, the organ builder and the church organist.

Göteborg: Casting Pipes on Sand

Whereas in Roden 'old sound' was produced by restoring an existing organ, the North German Organ Research Project at Göteborg University took a wholly different approach to reach the same goal. This project aimed at building a copy of the 1699 Schnitger organ in the Lübeck Dom, that was destroyed during a bombing raid in 1942, and of which only some photographs remain. In its time it was a famous organ. Johann Sebastian Bach travelled on foot all the way from Thüringen near Weimar, to Lübeck, to hear this organ and its organist, Dietrich Buxtehude. The scholars and craftsmen in the project that started in the early 1990s and was financed, among others, by the Swedish government and the European Union, built the new organ in the Örgryte church, one of the larger churches in Göteborg.

The aim of the project was to gain the theoretical and practical knowledge and experience necessary to construct, in a Swedish church, an organ in the way it might have been built by Arp Schnitger in the late 17th century in North Germany. Building an exact copy of the Lübeck Dom organ would be impossible, if only because it would not fit in the Swedish church. The ambition was therefore to come as close as possible to the 'language' of Schnitger:

'So, using the most coherent collection of pipework to survive from any Schnitger organ, we tried to learn about the craft processes that produced the original object, in order to *perform* them well enough to build a new object in the same language as the original. [...] Schnitger and his fellow organ builders knew what an organ looked like and sounded like, because they knew the patterns of the language that made up all of the things that it would have to do. [...] The historical instruments themselves have to be read just like any other primary source, to coax out and define what the pattern language really was for the Arp Schnitger school of organ building. Then the ways of working had to be understood, copied, tried out, and finally performed, in a continuous dialectic interplay between theory and practice.' (Speerstra, 2003: 18 and 19).

This quote is taken from a 400 page edited volume written by many authors, all of whom were involved in the project. It offers a detailed documentation of the ten year process. First, it describes how the dimensions of the new organ were deduced from the three remaining photographs of the organ in the Lübeck Dom by analyzing the position of the photographer, the distance to the organ façade, the relative angles, etc. It continues to document the construction of the organ case and the carvings, both made from Swiss oak. Much attention is paid to documenting the construction of the wind system and the pipes. Compu-ter simulations and full-scale model experiments were done to under-stand the wind flows in the wind supply system, from the bellows to the pipe feet. A method was reconstructed for casting the metal for the organ pipes on sand, according to seventeenth-century practice. In order to create a comparative perspective in which the Roden case and the Swedish project can be compared, I focus on two aspects of the project: the organ's pipes and the wind system.

As we saw in the case of the Hinsz organ in Roden, the production of the organ sound is a highly complex process in which the wind pressure is one of the critical parameters. The pressure at the pipe foot is the result of the wind systems response to the activities of the organ player and is, by nature, very unsteady. Changing flows create pressure waves that are spread through the wind system, interact with others, and are reflected at the system boundaries. The research necessary to understand these complex flows inside the organ's wind system was carried out at the Department of Thermo and Fluid Dynamics at Chalmers University of Technology. Here, the researchers built a laboratory model of a wind system as it could have been built by North German baroque organ builders. The flow of the wind inside bellows, trunks, windchests, and valves was measured to produce a data-model. Next to this, computer models were used to simulate wind flows. Measurements and computer simulations could thus be compared:

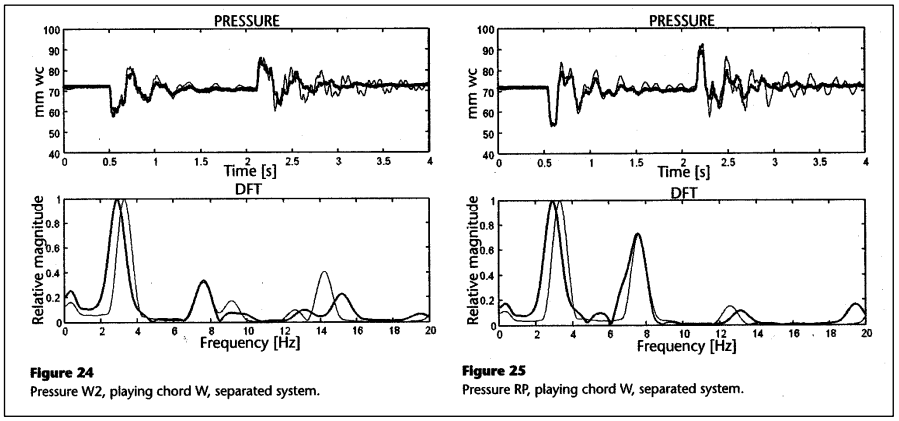

Figure 1: Relation between wind pressure and relative magnitude of frequencies in a chord. (Source: Speerstra, 2003: 130)

'Comparing calculations and measurements shows that the calculations give illustrative answers with respect to maximum amplitudes and frequency content in most cases. This indicates that the basic concept of modeling – tracing pressure waves – works quite well, and that the models of the components are mainly correct in this respect. However, large differences in damping exist between simulations and measurements. This is a general trend, observed also in other applications where a similar calculation technique is used. The reason for this is not fully understood and could be further studied' (Speerstra, 2003: 130-131).

Because the scholars were finally unable to say with certainty which type of wind system Schnitger chose, they came up with an ingenious solution. Instead of building one wind system for the new organ, they added extra channels and extra valves to the system to emulate three documented wind systems from Schnitger systems in Hamburg, Magdeburg and Zwolle, where twelve wedge bellows have been preserved. This bellows in turn served as a model for the bellows of the organ in the Örgryte church.

Parallel to the reconstruction of the wind system, scholars worked on the second crucial element in the production of organ sound, the organ pipes. A central question was why pipes from the 17th century sound so different, and usually better, then new pipes that had the same shape and construction.[13] To answer that question, the metal composition of preserved 17th century pipes was analyzed.

'The metal consisted not only of tin and lead, but also of impurities and trace elements, small levels of bismuth, antimony, copper, silver, and arsenic. These trace elements affect the hardness of the metal, the casting methods, and the workability of the metal.' (Carlsson [et.al.], 2000: 39)

When the alloys for the pipes had been determined, the next step was to relearn the 17th century practice of casting the metal sheets that are the raw material the pipes are made from. The casting starts with pouring the melt (basically a lead-tin alloy) into a wooden box (casting box) which has an opening at the bottom. The casting box is placed on a long and narrow table (casting bench). When the casting bench is pulled along the bench from one end to the other, the melt will run out and spread into a thin layer covering the bench. The melt cools down and solidifies into a metal sheet (see Figure 2).

Figure 2: Slanted casting bench, Plate LXIV from Dom Bédos, LArt du facteur d'orgues (1770). Source: Speerstra, 2003: 173.

'If the casting bench is moved at a constant speed, the metal sheet thins out toward the end, a characteristic that the 17th century organ builder calculated. Historic pipes are often thinner at the top, and therefore weigh less at the top than at the bottom, giving better stability and simultaneously a better resonance in sound.' (Carlsson [et.al.], 2000: 41)

In modern organ building traditions, the casting bench is made of stone or wood and it is covered with a cloth. In some earlier traditions, however, the casting bench was covered with a layer of sand. An important question was whether the material properties of the pipe metal were dependent on using sand or cloth when casting. When cast on sand, the quality of the pipe metal was very different from the metal that was cast on cloth. This had to do with the amount of time it takes for the metal to cool down. The sand bed causes a quick decrease in temperature, which results in a harder metal. According to the researchers, the casting temperature, the type of sand, and even the proportions of trace materials in the metal all had an effect on the end result.

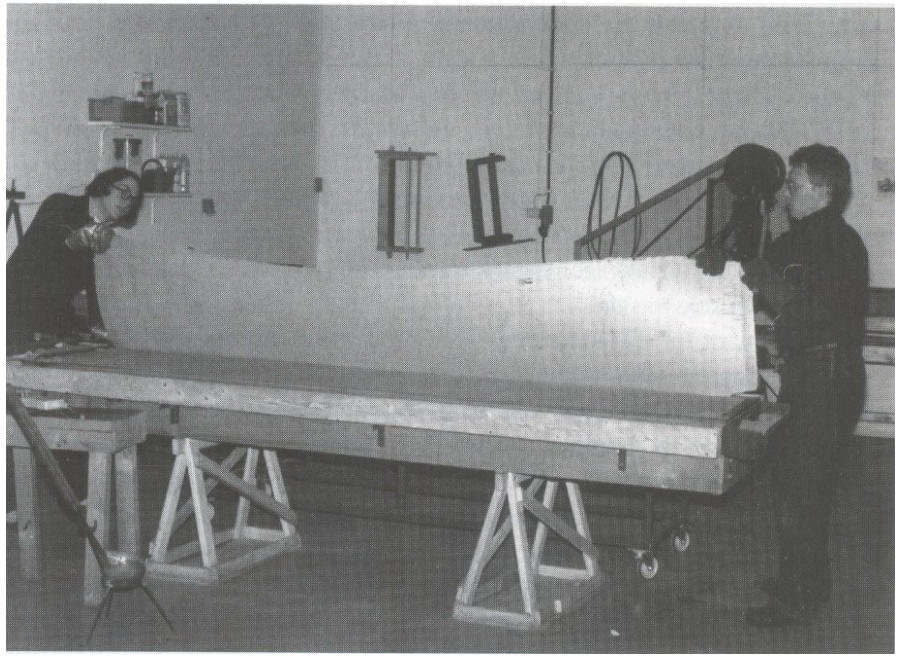

Figure 3: 'Turning the cast sheet onto a rolling cart. Sand can be seen clinging to the underside of the sheet.' Source: Speerstra, 2003: 212.

Researchers in the project tried to relearn the practice of casting metal sheets for organ pipes by finding answers to questions such as: did Schnitger cast on sand or cloth? If he cast on sand, what sand layer thickness did he use? What type of sand did he use? Did he mix any oil or water into the sand and if so, what type of liquid and how much did he use (see Figure 3). In a popularized account of the Swedish organ project, published under the title 'Tracing the Organ Master's Secret', the authors hint at the somewhat romantic image of craftsmen trying to unravel the secrets of the old organ master:

'Pipe casting is also its own art! Slow and careful training is required to be able to control the outcome of the casting process. [...] The material was respected, and both the sound and stability of the pipes maintained the most favorable quality. Workers skilled in traditional handcrafts have always operated with a great respect for the quality of traditional material, dimensions, the design, and size and shape of hand tools. This perspective reveals a complex interaction with significant implications for the end results, in our case, the acoustical quality of the organ pipes.' (Carlsson [et.al], 2000: 16).

Comparing Roden and Göteborg

Comparing the ambitious North German Baroque Organ project to the restoration of the Hinsz organ in Roden is of course problematic in many ways, considering the differences in scope, means and goals. The main similarity lies in the fact that both projects aimed at reconstructing the sound of the past. In both cases, this is done by studying the knowledge and practices of 17th and 18th century organ builders and trying to understand the material 'language' they spoke in building their instruments. In both cases we see a combination of scientific research methods and artistic debates on the preferred end result. The main difference is that in the case of Roden, the 'passage' to the past had a clear destination: an original organ embedded in a historical organ geography, that provided contexts for the decisions the organ restorers had to make. In the case of the Swedish organ the destination was not so much an existing organ, but a sound ideal, the sound of the North-German baroque organ as Arp Schnitger used to build. To reach this destination, the past was brought to the present by studying many different organs: the bellows came from Zwolle, the wind system from Magdeburg and Zwolle, the dimensions of the organ façade from Lübeck, the wood from Switzerland, the wind system from the computer simulations at Chalmers University.[14]

If both projects mobilize the past in different ways, what can be said of the different notions of 'authenticity' that are established in the process of restoring an old organ or building a copy of a historic organ? Neither the restoration team in Roden nor the scholars / craftsmen in Göteborg are as naïve to think that they could actually reproduce 'old' sound in the literal sense. However, this does not mean that the organ restorers and builders have given up the artistic *ideal* of original sound. Achieving this goal, however, does not depend on the availability of an original instrument, as was the case in Roden. As Harald Vogel, a German organist and organ scholar who was active in the Swedish project, writes:

'We have actually come to the point now where replicas come closer to the original sound than the surviving originals themselves. Building new instruments in historical styles is a path that we must take in the future. There are two reasons why we cannot take our antique instruments closer to their original state then they are now. The first is that there are additions to the original material that we cannot take away. The second is that, in restorations, we have not gone far enough in many respects. I think, therefore, that the Göteborg project is a turning point in the history of restoration and replica in Europe: ideally, restoration should always be related to a replica.' (Harald Vogel in Speerstra, 2003: 345.)

This statement resonates with a claim that Bruno Latour made in a recent article in which he attacks the notion of the 'original' in art. Great art is not a point of origin, he argues, but a trajectory, that can be compared to a river.[15]

'A given work of art should be compared not to any isolated locus but to a river's catchment, complete with its estuaries, its tributaries, its dramatic rapids, its many meanders and of course also with several hidden sources. [...] To give a name to this catchment area, we will use the word 'trajectory'. A work of art – no matter of which material it is made – has a trajectory.' (Latour, 2008)

Latour argues that it is useless to focus on the source, and forget about the trajectory. On the contrary, it is precisely the quality of the trajectory that renders the originality and the strength of a work of art. In the end, all art is reproduced constantly, be it in the performing arts through performances, or the visual arts in museums. Translating Latour's metaphor to organ restoration, we could say that the *work* scholars and practitioners

do in restoring old instruments or building replicas, is not so much travelling back in time to a vanished source of original sound. Rather they should be imagined as cartographers of the 'river's catchment'. They map the intricate trajectories the instruments followed, and by retracing and reproducing the 'old' organ sound, they actually add new branches to the river.

How did the researchers in Roden and Göteborg do this? In Roden the fact that there was an existing instrument that could be located in a historical organ geography helped the restoration team to create a point of reference. Yet, new elements were introduced, such as the wedge bellows that can be trodden by foot. Both the church organ player and the scientific adviser underlined that their work resembles the practice of organ builders like Hinsz: science, practical skills, and artistic preferences go hand in hand. In the end, it is the artistically trained ear of the expert that decides whether the organ sound is satisfyingly restored. In the Göteborg case, the general approach was that of a research project. It was the explicit aim to learn as much as possible about the language of organ builders like Schnitger. Here the distinction between original and replica became irrelevant for producing an 'original' organ sound. Computer simulations and measuring wind flows went hand in hand with the reconstruction of wind systems according to old examples. Determining the exact properties of alloys of pipe metal were combined with relearning the old practice of casting the metal sheets for the organ pipes.

Discussion: Constructing an Artistic Argument

The comparison between the Roden and Göteborg cases seems to corroborate Latour's metaphor: in both cases 'original' organ sound has to be *re*produced, the fact that an original instrument is present or not is not decisive in reaching this goal. But how then can we choose between the two projects in a normative sense? When is a restoration project a success or a failure? Following Latour, the importance here is not to distinguish between the original and the reproduction, but: 'Since all originals have to be reproduced anyway, simply to survive, it is crucial to be able to discriminate between good and bad reproduction.' (ibid). Discriminating between 'good and bad reproductions' implies normative criteria, but in his article Latour fails to outline them.

In order to distinguish in a normative way between the restoration projects, we first have to reconstruct their styles of scientific and artistic reasoning. In doing their work, the organ builders and restorers weave , what I call, an'artistic argument' using heterogeneous resources. How this argument is built can be analyzed using a standard model of argumentation. In this model a claim is backed up by evidence, that is in turn linked to the claim by a warrant, or general statement, that explains why the evidence is relevant to the claim.[16] Understood within this model, the research that the organ restorers do is aimed not at recreating the actual sound of the past, but at the construction of an argument that takes the material form of a musical instrument. Building this instrument and the sounds it produces can be compared to forwarding a claim. This claim is backed up by assembling a wide variety of evidence. This could also be seen as organizing 'relevant context'. In the case of the Roden organ, the 'organ geography' of which it is a part, containing other organs by Hinsz, is considered to be context. The same is true for the existing pipe material in the organ itself. Knowledge about the dimensions of the wind system is linked to the artistic ideal of 'breathing wind' and is thus turned into evidence for the organ-as-artistic argument. In the Swedish case measurements and computer simulations are seen as evidence, as well as the practice of casting pipes.

In the formal argumentation model, linking evidence to a claim implies specifying why this evidence is relevant to the claim. This is done by formulating a warrant, or general principle, that links the specific and situated evidence to the specific claim. In an 'artistic argument', warrants guarantee that the context that is assembled, in our case by the organ researchers, is actually accepted as relevant. In the Swedish project, the three remaining photographs of the organ in the Lübeck Dome are considered to be relevant context because the researchers agree upon the general idea that the sound of a baroque organ depends on the shape and dimensions of its façade. In the Roden project, the building of a bellows system that can be manually operated strengthens the argument because

the researchers agree about the general principle that the irregularity of the wind flows inside the organ adds to the quality of the organ sound.

When looking at the way the restorers and builders link evidence to their claim, we notice that there are major differences. An example is the influence that the casting of pipes on sand has on the tone quality. According to the Roden church organist, this material evidence is not at all relevant to the claim of a better sound.

'We now have this new hype, casting pipes on sand. This is how they did it in the past. I don't believe it makes a real difference in sound. I always say: casting pipes on *quick*sand.' (Interview with the church organist).

This quote illustrates how the artistic argument the Göteborg team made is attacked by one of the members of the Roden team. Instead of referring to past practices as a neutral criterion, the relevance of this practical knowledge to the claim in the artistic argument is rejected. In other words, the Roden church organist challenges the 'aesthetic frame' that underlies the argument of the Göteborg team. These frames consist of the general ideas and principles that serve as warrants in artistic arguments. Contexts that counts as valid in one aesthetic frame are not valid in another. The metallurgical knowledge to produce replicas of old organ pipes is valid only if we argue from the general principle that old organ pipes sound better than new ones. The practice of casting pipes on sand can only be convincingly mobilized as relevant context if we accept the general insight that the density and chemical make-up of an organ pipe have an audible influence on their sound. Comparing both cases in a normative sense, then, implies a comparison of the different ways their artistic arguments are built.

Conclusion

Church organs can be considered as *technologies*. To understand what makes them *artistic* technologies, I have analyzed the way organ builders and restorers argue for the claim that they are able to recreate the sound of old organs, either through restoring an existing organ in the village of Roden or by building a replica of an organ that once existed in the Lübeck Dom. Instead of arguing from the pre-given categories of science and art, I have opened an STS-perspective on organ restoration. By analyzing a restored organ or a replica of an old organ as a 'material argument', I focus on the various knowledges, skills and practices that are necessary to back up the claim of 'old sound'. In what ways does this perspective contribute to the debate on research in the domain of the arts?

First, this approach helps to move beyond the conceptual dualism of science and art. Instead of transgressing boundaries between clearly demarcated disciplines, both of which can be said to have their own logics, I focus interest on the heterogeneous context that is mobilized to make an 'artistic argument' convincing. Thinking in these terms about organ research and restoration poses the question of what general ideas and principles are needed to make this context relevant to the claim. The cases show that in order to make a claim artistically convincing, scientific context is introduced and vice versa.

Second, in terms of setting a research agenda, considering organs as artistic technologies opens a variety of empirical research strategies. Analyzing how organ researchers assemble relevant contexts, and how they reason to make this context relevant to their (artistic) claims can enrich our understanding of musical practices and cultures, as well as further our second order understanding of the debates and discourses that structure these practices and cultures. Who are the participants in these debates, and how do they construct their epistemic, practical, and artistic authorities in the actual practice of building a material argument?

Finally, by focusing on the structure of artistic arguments, we can learn more about what could be called the 'aesthetic frames' that underlie them. The whole project of the historical performance practice, including the (re)building of old instruments, rests on the 'aesthetic frame' (warrant) that performances on period instruments according to period practices are necessary to give artistically convincing renderings of early music. This aesthetic frame might not be shared by someone who argues the artistic quality of a performance depends on the subjective expression

of a performer, as was done in the days of musical romanticism. In terms of art criticism, analyzing aesthetic frames thus helps to specify the often implicit criteria that are used to distinguish between what Latour calls 'good and bad reproductions'.

Retracing old organ sound by studying the work of organ restorers and builders of replicas at first seemed to entail an upstream passage to a silent world of authentic sounds. In fact, what they do is to construct material arguments and thus add new downstream tributaries and branches. In other words, their research does not restore something that was already there, but can be seen as a form of continuous artistic innovation.

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[1] The ad hoc collective work that goes into the creation of a historic organ over the years can be compared to the building of Gothic Cathedrals as a discontinuous process (Turnbull, 1993).

[2] It should be noted, however, that the organ can also be considered a technology that (re)produces a social or religious order, such as when it is used to accompany the singing of a congregation.

[3] According to a conductor like Willem Mengelberg (1871-1951), recreating the musical past always assumed a subjective interpretation of the score, where the expressive personality of the performer greatly contributed to the artistic quality of a concert. Especially in the case of baroque music, this resulted in performances that, in our ears, sounded as through a romantic prism, as can be heard in a 1940-recording on the Concertgebouw Orchestra performing J.S. Bach's *St Matthew Passion* under the direction of Mengelberg.

[4] In his book *Musik als Klangrede*, the conductor Harnoncourt countered this criticism. In an age of airplanes, televisions and computers, he argued, early music has lost its meaning. People are no longer able to understand it as a language. Music from previous

epochs had become an ornament that was meant to be 'beautiful'. The goal of musician-researchers such as Harnoncourt was not to ban early music to the museum, but instead to create modern interpretations of master pieces in which the performance and listening conventions shaped in the past decades were questioned (Harnoncourt, 1983: 9, 10).

[5] As Van Dijk (2000: 19) points out, these changes in the practices of organ building and organ restoration were accompanied by 'tumultuous' debates in which opponents disagreed on the relevance of historical approaches to the artistic quality of an instrument.

[6] In the 1970s and 1980s, records of historically informed interpretations of well-known compositions by Bach and others were often labeled by record companies as 'authentic performances'. The moral and ethic overtones in the concept were thus linked to commercial interest. C.f. Haynes, 2007: 10: 'Authenticity became a hexed word and served for a while as a kind of lightening rod for anybody who was dissatisfied with some aspects of the Movement [early music movement – PP] Despite this, the idea that the word represents refuses to go away. The reason is clear: Authenticity is simple, it's logical, and (as we have seen) it's central and essential to the concept called HIP.'

[7] Various interesting approaches can be found to answer the question 'wie es wirklich gewesen ist', in the hermenutic tradition of Schleiermacher, Dilthey, and Gadamer.

[8] This region houses an amazing number of old and very old organs, that for the most part have been preserved in a relatively unchanged state. One of the reasons for this was, that most congregations simply did not have the money to pay for extensive modernizations of their organs.

[9] Almost all parts of the organ were taken apart, cleaned, repaired or sometimes replaced. The wind system was reconstructed and new wedge bellows were built. The wind chests were reconstructed to the situation of 1780. Both the key actions and the stop mechanisms were cleaned and repaired. The two keyboards of the organ, that had been raised to a higher level during a restauration in 1955, was lowered – not to its original height, as this would have left the organ virtually unplayable for modern organists, but halfway. The original and worn ivory on the keys was left as it was, to keep the yellowed patina of the keyboard. A new pedal board was made, based on an example of a Hinsz pedal board that is still in use in Uithuizen (Groningen). As with the placing of the keyboards, a compromise had to be found because modern players have longer legs and larger feet. The ornamental carvings in the casing were cleaned and the oak wood was newly varnished. (My account of the restauration of the organ is based on Nes & Boerema, 2006 and on interviews with the scientific adviser and the church's organ player.)

[10] For this article, I interviewed the scientific advisor and the church organist.

[11] Flue pipes produce their tone when the air from the wind chest escapes through a fipple, a principle that can be compared to the tone production on a recorder. The visible pipes in the organ front are flue pipes. Reed pipes produce their tone as the escaping air passes a reed, comparable to a clarinet. Both families have a whole range of members, some of them made from metal, others from wood. Some pipes are long and thin, others short and wide. They can be conical or straight, open or closed at the top. These physical characteristics determine the overall pitch and tone colour of a pipe.

[12] In the testing report that was written in 1780 after Hinsz had finished the organ, the organist Jacob Wilhelm Lustig wrote: 'de blaasbalgen, canalen en windladen / de longen ademen, en 't hart des orgels / gezond en van alles wat naar quade ademtogt zweemt, 't eenemaal bevrijd'. [the bellows, canals and windchests / the lungs breathing, and the heart of he organ healthy and freed of everything that hints at bad gasps].

[13] Munetake Yokota, who was responsible for the making of the pipes for the new organ in the Örgrye church, defines this historic sound as follows: 'These old pipes have a beautiful balance between "musical sound" and "noise", as well as a good sense of balance between the strength, length, and character of the speech and the sustaining tone. [...] Was the old sound partly a product of the aging of the materials, or could we reach this level of quality again in a modern instrument? Essentially I define "good sound" as sound that has a sense of life. The listener senses the life from the sound of each pipe, each stop, and several stops together interacting symbiotically just like in human society.' (Yokota, in Speerstra, 2003: 165).

[14] The contrast of between the historic and geographic situatedness of the Roden organ and the 'placelessness' of the Swedish copy reminds of the distinction between places and non-places that Augé (1995) makes.

[15] I thank Vivian van Saaze for pointing out this article to me.

[16] I take this model from Booth [et.al.], who in turn refer to the Toulmin argument formalism. Building a 'material argument' can be compared to what Latour (1987) describes as 'science in action': 'To determine the objectivity or subjectivity of a claim, the efficiency or perfection of a mechanism, we do not look for their *intrinsic* qualities but at all the transformations they undergo *later* in the hands of others.' (Latour, 1987: 258). 'Material arguments' can thus be seen as 'a gamut of weaker and stronger associations' (ibid., p. 259).