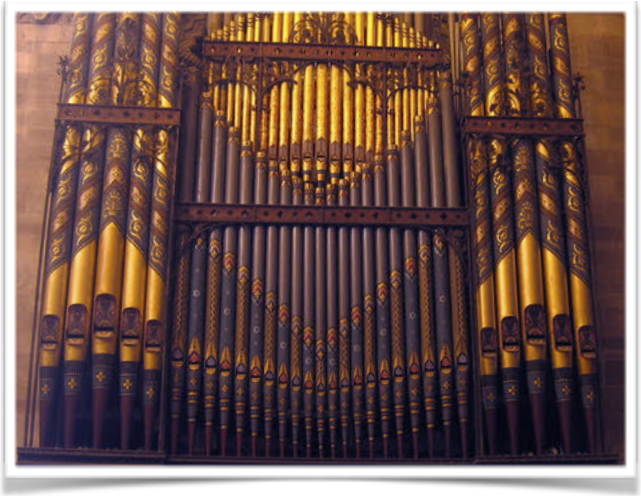

The Frankenorgel

Creating a Musical Monster

During my college years and for a number of years thereafter, I had a burning desire to somehow obtain a pipe organ of my own. With the cost of a decent custom-built home instrument easily touching $150,000 in today's dollars, a new one

was absolutely out of the question. I acquired my first rank[1] of pipes – an 8'[2] *Horn Diapason* originally installed in the Salt Lake Tabernacle organ – from Mike Ohman, curator of organs at BYU, as payment for my work to help remove the organ from the Joseph Smith building on campus, which was scheduled for demolition. Within a short time, I had also obtained an old Wicks console, a blower, a wind chest, and a few other ranks of pipes including a 4' *Open Wood Melodia* and some kind of 4' spotted metal[3] string. It seemed I was well on my way to having something I could cobble together that would one day be playable. But pipe organs – even used ones – are expensive and take up a lot of space. Eventually, it became apparent that my desire for a pipe *organ* was nothing more than a pipe *dream*.

Fast forward to about 2006. Through a mutual friend, Mark Smith, I became acquainted with Rob Stefanussen, who was working toward becoming a *Guest Organist on Temple Square*[4]. Mark and I made a visit to his home to see something I had never heard of: a *Hauptwerk Organ*[5]. Through the magic of digital sampling and computer software, here was a new tool to emulate a pipe organ for a tiny fraction of the cost. The wheels in my mind began spinning. For the first time, I thought seriously that a "pipe organ" – even *a large one* – was in my future.

MIDI stands for **M**usical **I**nstrument **D**igital **I**nterface. With the right combination of software and encoding hardware, anything capable of sending an on/

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[1] A *rank* is a single set of organ pipes that go together (e.g. Flute, Trumpet, Gamba) and play the range up and down the keyboard, with one pipe per note. The size of an organ is usually expressed by the number of ranks it has. For example, the Salt Lake Tabernacle organ's 11,623 pipes comprise 206 ranks. Some stops are made up of two or more ranks, and are usually indicated by a roman numeral indicating the number of ranks in the stop (e.g. Mixture IV).

[2] Organ pitches are expressed in number of feet. An 8' stop sounds at "unison pitch," or the pitch that would be heard if the same note were played on a piano. Each halving or doubling of the length results in a pitch change of an octave, up or down. Thus, a 4' rank sounds one octave higher, and a 16' rank sounds one octave lower.

[3] A common organ pipe metal consisting of an alloy of tin and lead (roughly half and half, depending on the desired mixture) that when cooled, has a characteristically mottled appearance.

[4] Guest Organists (I am one) are volunteer recitalists who play in the daily half-hour demonstration recital series in the Salt Lake Tabernacle, and during the summer season, in the Conference Center.

[5] *Hauptwerk* is the German word for a division of the organ (typically the largest and loudest part of the organ), called the Great division in English. *Hauptwerk* is also the trade name for an organ emulation software package from Milan Digital Audio. https://www.milandigitalaudio.com/hauptwerk/

off signal can be made into a musical instrument with sounds (sampled or generated) provided by a computer.

My first attempt to convert an analog organ to MIDI ended in disaster! I had obtained an early 1970s Conn electronic organ for $80 that I found in the local classified ads. One snowy evening, my friend Phil and I borrowed a relative's pickup truck and traveled up near Hill Air Force Base to retrieve it. Having worked with electronic organ keyboards before, I thought I knew what I was looking for. I dived right in and started removing (and, because I didn't think I needed to be careful, destroying) old analog hardware. About 1/3 of the way through, I realized that the pieces I was removing that I assumed were *covering* the key contacts[6] ***were***, in fact, the key contacts. The conversion process came to a halt, and for about 2-3 months the old organ console sat in my garage, partially disassembled, while I tried to think of a reasonable way to repair what I had done. At length, when no solution came to mind, I recycled the electronic parts and gave the shell of the console to the dog to sleep in.

Some time after that, my mother-in-law announced that, after we had moved to Tooele, nobody felt comfortable playing the old Rodgers organ they had obtained for me in the Ruby Valley[7] Branch LDS Chapel. Would I like to have it?

Yes!

Knowing its potential, I asked them to bring it out to me in the back of the pickup truck on one of their runs to Salt Lake City. Because of my earlier conversion attempt, I was completely gun-shy about converting this one, though I knew it was both possible and desirable. I put it in the basement and played it in its unchanged analog state for close to a year. Finally, I worked up the courage to take it apart far enough to do some exploration. I found the key contacts were exactly as I had

[6] Key contacts are usually thin wires that complete a circuit when pressed down by the key above them, sending the "on" signal when a note is played. The contacts in the Conn organ were unlike anything I had ever seen before.

[7] A beautiful ranching community in northeastern Nevada, near Elko, nestled at the foot of the Ruby Mountains. We lived there from 2003 to 2008.

expected to see the first time, and they were easy to get at! I ordered the MIDI conversion hardware from a vendor in Bulgaria[8] and got to work.

This was the beginning of ***The Frankenorgel***[9]. It is comprised of two early-1970s-vintage analog Rodgers electronic church organs, each having two 61-key keyboards (manuals) and a standard AGO[10] 32-note pedalboard. These two consoles have been "surgically" joined to form a single organ console with 4 manuals that has in turn been converted into a *MIDI controller*.

The analog tone production capability has all been removed from the Frankenorgel. By itself, even this large and complex MIDI controller cannot produce any sound. It merely sends on/off signals (as keys or buttons are pressed) to a computer loaded with *Hauptwerk* organ emulation software, which receives and interprets these signals and sends out digital samples of real organ pipes corresponding to the notes that have been pressed. These sounds are then routed back through an Audio/MIDI interface – essentially an external computer "sound card on steroids" – through an amplifier, and out through speakers or (my wife wishes) headphones. Since it is possible to "play" these virtual organs, one note at a time, with the click of a mouse, it could be said that the Frankenorgel is like a mouse — with over 276 buttons.

A significant part of the conversion involved soldering a wire separated out from a length of ribbon cable leading from *each* key contact and push button (thumb pistons and toe studs[11]). These cables led to a connector that plugged into a "key multiplexer" printed circuit board, which was in turn connected to a MIDI encoder that supplied all the on/off signals to the computer. My son Andrew, who was probably 11-12 years old, and who was not really interested in organs yet, lent a hand

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[8] MIDI Boutique, operated by Jordan Petkov. Jordan was also very helpful guiding me to exactly the right hardware to do a successful conversion. midiboutique.com

[9] *Orgel* is the German word for organ.

[10] **A**merican **G**uild of **O**rganists, the professional society for organists across the country, which has set certain standards for organ construction.

[11] Buttons operated with the hands or feet that, with a single press, will perform some function on the organ that would be difficult (if not impossible) to do by hand while playing, such as changing multiple stops at once.

and did a fair bit of the soldering and other tasks himself. Because I was unsure of the length of ribbon cable I would need for each segment, I could not order pre-finished cables. Instead, we had to assemble the connectors and crimp the ribbon cables ourselves. Lacking a real crimping tool, we wondered at first how best to crimp the connectors without investing in a specialized tool we would use for only one job. After some thought, we had good success with a tortilla press!

My friend, Irwin Arnstein[12] (Dallas, TX), whom I met at first only online, was a big help in the process. He gave me a lot of good guidance and advice. We have subsequently met in person a number of times and are now good friends. Once the soldering began, the rest of the process went fairly quickly. The conversion was a complete success. I was using the free version of the *Hauptwerk* organ emulation software, and downloaded free sample sets of a few small and largely unknown pipe organs. My total cost up to this point was about $400, including the organ I had destroyed earlier in my over-confidence.

After about another year, a member of the Tooele Utah North LDS Stake High Council approached me and said "the Tooele Third Ward building is getting a new organ." After asking for my recommendation on what kind of electronic organ to replace it with, he asked if I knew of a home for the old one.

Indeed I did!

I paid the $200 purchase price to Deseret Industries (DI)[13] for the old organ and speakers, and transported them on a trailer to my house. Getting this big console down to the basement was a trick. It was much too large and heavy to move down without partially disassembling it. I removed the keyboards, amplifier, and power supply. Even after lightening it considerably, we still managed to make a hole in the back wall of the stairwell when one of the corners escaped our grasp as we struggled down the stairs.

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[12] irwinarnstein.com

[13] The Church of Jesus Christ of Latter-day Saints (LDS Church) sells certain surplus items indirectly through DI, a chain of thrift stores owned and operated by the Church that trains employees in a range of career fields to enable them to find work specific to their skills.

Figuring out *exactly* what to do with this “new” organ initially took some time. It was a nicer and larger console than the one from Ruby Valley. Should I convert it and sell the other one? I had some emotional attachment to the old one, and was reluctant to part with it completely. Soon I realized I could combine the two and have a 4-manual organ. It seemed extravagant, and would require purchasing the "professional" version of the *Hauptwerk* software (about $500) and some additional MIDI hardware from Bulgaria (about $250) to enable use of the other two manuals. Having a console with four keyboards would also be silly overkill without a 4-manual organ to go with it (about $500, and the main reason I needed the professional version). After working out the physical details of how to support the weight of two *additional* keyboards (which are quite heavy) in a console built for only two, I got to work.

I placed a wooden rail across the back of the console and fashioned a shelf out of a stout piece of particleboard. Because the keyboards from the Ruby Valley console have extra wide keycheeks (wings that extend from either side) that could not be removed, I had to remove the keyboards from *both* organs, mount the Ruby Valley keyboards to the 3rd Ward console, and then remount the 3rd Ward keyboards above the Ruby Valley ones, resting on the shelf I had constructed.

Because it was never intended to contain four manuals, the lid of the 3rd ward console covered all of the fourth, and part of the third manual, leaving only a narrow slot between the top of the keys and the bottom of the lid. It was not playable in this condition. More research was needed to figure out how best to cut the wood veneer top panel without ruining the veneer. Research done. Cut made. Decorative slats stained and screwed over the exposed sides. The console was complete!

For a time, I continued to use the two small speakers and amplifier from the refurbished Sony stereo I had purchased a decade or more prior. These were only ever just "adequate," and I yearned for some larger Yamaha Studio Monitor Speakers which would fill the basement with very clean sound, but came at a substantial price. The original Rodgers speakers that came with the 3rd Ward organ looked like junk. They were big and dusty, and clunky-looking, with all speakers exposed and rips in

the foam surrounding the subwoofers. I assumed I would be donating them to DI. Before giving them away, I decided to try them out.

Wow! There is something to be said for having multiple large speakers designed to fill a large chapel with organ sound (even if that sound is analog). Because the speakers were so large, I needed a different amplifier that could put out sufficient wattage to drive them with any kind of volume. I mentioned this need to Kelvin Wallin, whom Andrew and I Home Taught[14] at the time. He happened to have an older home theater amp laying around that produced sufficient wattage to make full use of the speakers. Prior to this, I had to use headphones or turn the organ way down to avoid distortion. Following the installation of the new amp and speakers, I was finally able to turn it up loud! I asked my wife "so... were you able to *hear* the organ upstairs?" She answered "I think the people down the street heard the organ!"

The Frankenorgel has remained basically unchanged for the past few years. I did purchase an additional touchscreen monitor[15], doubled the RAM[16] in the computer, and upgraded the original hard drive to an SSD[17], resulting in an increase in performance. Mike Ohman gifted me five toe studs, and I purchased an additional matching expression pedal ("loud/soft") from a seller on eBay, who remains a Facebook friend to this day. Most recently, I bought thirty additional thumb pistons,

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[14] Home Teaching is a program in the LDS Church whereby members make frequent visits to the homes of other members for the purpose of teaching, fellowship, helping in times of need, etc.

[15] With a sufficiently large console, the existing (or purchased) stop knobs, tabs, etc., can be used to control the functionality of the organ. These are wired into the MIDI controller the same as the notes on the keyboard. When the Ruby Valley organ was first converted, I had enough of everything to control the small organs I was using. Larger organs frequently require a touchscreen monitor to display a (usually) photo-realistic image of the console. The organ is then controlled by touching the required item.

[16] In a *Hauptwerk* system, the *entire* organ is loaded into the computer's memory (RAM) when the organ is started. This is to enable near-instantaneous retrieval of a sampled sound when it is triggered. If the computer had to retrieve each individual sample from the hard drive, the process would be prohibitively slow, resulting in a considerable delay. A larger organ naturally requires more RAM for the organ to be loaded without significant compression. The more compression, the lower the sound quality.

[17] A Solid State Drive (SSD) has no moving parts. Loading a large organ (several gigabytes or more) from a traditional hard drive is rather slow. The SSD greatly speeds up this process. The Hereford Cathedral organ used to take nearly two minutes to load, whereas now this time has been shortened to about 20-30 seconds.

but haven't yet mustered up sufficient desire to do the carpentry and wiring work necessary to install them.

With the upgrade to the paid edition of *Hauptwerk,* I also purchased sample sets (samples of the entire organ, including the noises it makes – key clicks, stop action, blower, etc.) of the English Romantic 4-manual Father Willis organ (Hereford Cathedral, England), the Early-Baroque 3-manual Huß-Arp Schnitger (St. Cosmae church, Stade, Germany), and a 2-manual French Romantic Cavaille-Coll (St. Eucaire church, Paris, France). Altogether, these sample sets cost about $1200. The cost of the actual Hereford Cathedral organ if it were built today would likely exceed $2 million!

There is an old saying: "The most important stop on the organ is *the room*." Acoustics play a huge role in the sound of an organ. Even a great organ in a bad room will sound bad. Because the organs sampled for use with *Hauptwerk* are typically sampled out in the room, the reproduction is extremely authentic from a listener's perspective[18] and includes the natural warmth and reverberation you would hear if you were standing in the actual church while the organ played. In short, my basement sounds like the Hereford Cathedral. Or the St. Cosmae church. Or the St. Eucaire church. Or…

For now, my conversion days are accomplished. I have acted as a consultant to a few other people who have embarked on conversion journeys of their own. It is possible to accomplish all this without the need for conversion by purchasing off-the-shelf MIDI hardware. One such vendor is Classic MIDI Works[19], a Canadian company specializing in modular hardware enabling someone to build a fine console in a small fraction of the time it would take to convert an old one. There is some *really* good quality stuff available, but it is quite costly. For example, each keyboard is about $2000. To build a complete 4-manual console similar to the Frankenorgel using all new MIDI hardware would cost upwards of $12,000. It may seem like a lot of money, but even this is pocket change compared with the outlay that would be required to

[18] The sound heard at the console, even in a good acoustic space, is often very different than what is heard "out in the room." These organ sample sets are generally sampled at the most favorable position in the room, and won't necessarily reflect the true sound one would hear at the console (which is usually not as good).

[19] https://www.midiworks.ca

purchase a fairly modest digital electronic organ from one of the major manufacturers. And such an organ would not have the inherent flexibility of a *Hauptwerk* organ.

Though I yearn for the luxury of solid hardwood, tracker-touch[20] keyboards with numerous thumb pistons, I cannot justify the expense at this time.

Maybe someday!

[20] A "tracker organ" is a mechanical-action organ that employs narrow wooden slats (trackers) to transfer motion from the keys to the valves underneath the wind chest that enable air (or "wind") to flow to the pipes. Though tracker action organs are all unique individuals, and are thus somewhat different from each other, the action has a certain characteristic feel that is artificially replicated in tracker-touch keyboards.