The Voices Behind the Boxes

A Virtual Choir Installation for Thomas Tallis' *Spem In Alium*

An Interactive Qualifying Project Report

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by

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Introduction

Spem in Alium is perhaps the most famous piece of the great Elizabethan composer Thomas Tallis. Requiring forty singers divided into eight groups of five, it is one of the more complicated and difficult works to ever be written. Although it has been performed many times, it continues to challenge many skilled singers and conductors in the world. Thus to hear it performed live is a very rare and moving musical experience. Sadly, most people will never hear the piece live. With today's technology however, it is possible to perform the piece at the push of a button and still maintain the musical integrity.

The idea is to use a virtual choir, which calls for each voice to be recorded and played through a speaker rather than performed by a live singer. For Spem in Alium, forty speakers would be required. The first important benefit of this installation is that it allows for the performance to be played at any time and for as long as desired. This makes the piece much more accessible, so more people will hear and enjoy it. In addition, the speakers can be arranged in different configurations, allowing for new ways to experience the music. For example, Tallis wrote the piece to be performed in an octagonal banquet hall with a ground floor and first floor balcony. By positioning the singers in a particular order, the music would travel around the circle, north to south, east to west, and up and down while the music progressed. There are numerous other ways the voices can be arranged to achieve many unique musical experiences. I have designed three different speaker configurations for this work, one based on Tallis' original intent, one based on a previous virtual choir installation of the piece, and one designed to emulate a typical live performance setup. Each one will provide a different way to hear

to the music, and thanks to the technology of virtual choir, the speakers can simply be unplugged and moved to different positions to try even more configurations.

Installation Setups

I have created three different speaker configurations for this installation. Each arrangement is designed to provide a unique experience and expose the listener to new ways of hearing the piece. Each setup has its own benefits and the only way to be sure which is best is to build them. These are certainly not the only possible configurations, though. With virtual choir, hundreds of other setups could be designed and tested to provide a fresh perspective on the piece.

Octagonal Configuration

The first setup I am proposing is designed to emulate the actual banquet halls the piece was performed in during medieval times. There are stories that tell of Tallis' choirs performing in octagonal banquet halls at castles such as Arundel Castle and Nonsuch Palace. These rooms all had balconies which were taken into account when Tallis wrote the piece. He arranged the music to be performed with four of the choirs standing on the ground level while the other four stood on the first floor balconies. The sound would not only travel around the circle, but also come from different heights as the piece progressed. There are even portions where the voices call and respond to each other in a north-south east-west pattern.[1] Unfortunately, there is very little additional information available about the details of this setup. The exact dimensions of these banquet halls and facts about which choirs were on the ground level or balcony are unknown. Therefore this setup may not perfectly emulate the original performances. It would be a challenging

[1] Philip Legge, "Spem in alium nunquam habui (Thomas Tallis)," Chorale Public Domain Library, 4 April 2006 <www.cpdl.org/>.

and time consuming process to analyze the music enough to determine the placement of each voice. Virtual choir would make this easier though, because the speakers could be arranged in the octagonal pattern, and then input signals could just be moved from speaker to speaker until the correct order was found. Some sources argue that the singers were arranged in order by when they started singing. The first person in the circle began the piece and the fortieth performer was the last to join in.[2] This has not been confirmed though, so more research in this area would be worthwhile.

The actual dimensions for my proposed setup are shown in figure 1. The speakers are arranged in an octagon with a seventeen foot radius, with each side representing one of the eight choirs of five voices. Within each choir, each speaker should be positioned thirty inches away from each other with all speakers projecting parallel to each other towards the middle. At the ends of each group of five, there should be twenty-seven inches separating each choir. These dimensions were chosen in order to both fully utilize the available space in Alden Hall and also maintain an intimate musical experience. If the octagon is too large, the listener may not experience the piece on the personal level that is desired. By contrast if the octagon is too small, the listener won't be able to distinguish one voice from the other.

Because it is unknown which choirs were standing at which level, I recommend having every other choir be at an average head height of five two inches feet, representing the singers on the ground level. The remaining choirs would be at raised to nine feet and two inches, the maximum height of the stands. There is a good chance the actual balconies used were taller than nine feet, but we are limited by the adjustability of the stands. It may be possible to suspend the speakers from the ceiling in order to mount

[2] "Thomas Tallis – Spem In Alium," Good Music Guide.com, 5 April 2006 <www.good-music-guide.com>

them higher, but this would make the setup much more complicated and because the true dimensions are unknown, it may not be worth the trouble. Perhaps a simpler solution would be to place the "balcony performers" on risers to gain some extra height. Again, the exact details of this would perhaps have to be worked out when the installation is completed and the speakers can be moved while the piece is being performed.

Circular Configuration

The second possible installation setup is based on the work of Canadian artist Janet Cardiff. Cardiff has worked with music throughout her career and has recently been focusing on three-dimensional music. This involves sounds coming from different directions at different times during a piece. Spem in Alium is a perfect opportunity for such a concept. With so many voices and so much detail about where each voice should come from, there are many possibilities for presenting this piece three dimensionally. Cardiff also used a virtual choir and her work has been displayed at several museums throughout the world. The setup she used was a circle with all the speakers at an average head height. The speakers were divided into eight groups of five, as it was originally performed. Her main reason for using this setup was so the listener would be completely enveloped in sound.[3] The listener can fully experience the north-south east-west variations that Tallis incorporated. It is also in some sense, the most genuine way to present the piece. All of the voices are at the same distance, angle, and height relative to the listener. When standing in the center of the circle, there are no physical discrepancies in where the sound is coming from. This allows for the listener to experience the music as a whole much more purely.

At the same time, the listener can do the opposite and experience the music in individual pieces. One can walk around the circle and focus on a single voice or choir much more effectively than with Tallis' original setup. This is yet another advantage of using a virtual choir. At a live performance, the listener often can't distinguish one voice from another because the choirs are generally on stage. With this setup though, the

[3] Shawn Van Sluys, "Canada Artist Portraits – Janet Cardiff," Galleries West, 19 April 2006 <www.gallerieswest.ca>.

listener can focus on a single voice while not disturbing the performer. Were the interaction between two live people, the singer and listener might feel uncomfortable being in such close quarters, affecting the music and listening experience. People are likely to feel more relaxed standing next to a speaker, allowing them to devote all of their attention to the music.

As with Tallis' arrangement, the exact dimensions and specifications of Cardiff's setup were not available. Thus I have modified her setup to what I feel is appropriate for Alden Hall. The circle, like the first setup, uses a seventeen foot radius. Each speaker is thirty-two inches apart and five feet tall. Again, these dimensions were chosen to keep the musical experience intimate but still allow the listener to focus on a single voice.

On Stage Configuration

The final arrangement that I propose is meant to emulate a typical live chorale production. Most live performances have the singers standing in rows on risers with increasing height from front to back. This allows the back rows to project over the front so all of the voices can be heard. The same idea is used in this speaker installation. There would be four rows of speakers, with each row containing two five-person choirs. It is difficult to predict what kind of experience this setup will create. The piece was not written for such an arrangement and there are no records of it ever being performed like this. It will make for an interesting comparison though, as most chorale works weren't written to be performed in an octagon as Spem in Alium was. The meaning and sounds could be completely changed, providing a new way of experiencing the piece.

The specific dimensions for this installation are designed for the stage in Alden Hall. The first row will be five feet tall, the second row will be six feet four inches, the third row will be seven feet nine inches, and the back row will be nine feet tall. The speakers in each row will be forty-eight inches apart and there will be thirty-six inches between each row. Thus the entire choir will require a thirty-seven by twelve feet.

Equipment

Finding equipment for such a project is a challenging task, with the most important component being the speakers. High quality monitors are required, but they must be small and light enough to be moved easily. After much online research and speaking with a manager at a local Guitar Center store, I recommend the KRK Rokit 5 Powered Studio Monitor by KRK Systems. This is a 16 pound powered speaker that requires no additional amplification and has volume adjustability on the back panel. It is comprised of a one inch tweeter and a five inch woofer. It also features XLR, ¼ inch TRS, and RCA inputs, and it plugs directly into an electrical outlet.[4] The Rokit 5 has received excellent reviews as being both affordable and extremely high-quality, particularly for acoustic and vocal performances. It is biamplified, which means that there are separate amplifiers built into the speaker cabinet for the woofer and tweeter. This feature is generally found only in high end monitors and it results in a cleaner and more balanced sound.[5] Based on my research, I feel that this speaker will be perfect for this project due to its combination of small size, high quality design, and affordability. There are certainly better monitors available, but for an installation requiring forty speakers, price is a major factor.

The only drawback of the Rokit 5 is that it is flat on the bottom, meaning it was not designed to be mounted on a normal speaker stand. Fortunately, Ultimate Support provides a solution for this problem though. The BMB 200K mounting bracket is a square bracket that attaches to the top of a standard 1.5 inch diameter speaker stand. The

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[4] "Rokit Powered 5 Powered Reference Studio Monitor," KRK Systems, 19 April 2006 <www.krksys.com>.

[5] Stan Aronson, "KRK Rokit Monitors – Entry-Level Price, Pro Performance," Musicians Friend, 29 April 2006 <www.musiciansfriend.com>.

speaker can then be attached to the bracket using screws. I contacted KRK Systems to find out if screwing into the bottom of the Rokit 5 would damage it in anyway. They assured me that as long as short screws were used, there would be no damage to any of the electrical components or the sound quality of the monitor.

Ultimate Support also offers some of the tallest speaker stands available. The Telelock TS-99 series is a professional quality stand that can be adjusted to a maximum height of 9 feet 2 inches, the tallest I was able to find. While this may be a little shorter than the balconies in a medieval banquet hall, it should emulate the effect quite accurately.

Of course forty speakers can't just be plugged directly into forty electrical outlets. With so much current being drawn through so much expensive equipment, it is crucial that a high quality surge protector be used. The Monster Pro Audio PRO 1000 surge protector is designed specifically for high end audio equipment. It has eight outlets and offers 2,775 joule surge protection. In addition, it is designed to filter out electronic noise to improve sound quality of the monitors.[6] Each surge protector has eight outlets, so five would be needed to accommodate the forty speakers.

Because of the quality and ingenuity of the Rokit 5 Monitor, only two types of cables are required to connect all of this equipment. To power the speakers, standard 2500 Series three-prong power cables can be used, while ¼ inch TRS audio cables can be used to connect the synthesizer outputs to the speaker inputs. These simple connections will certainly be useful when rearranging the configuration of the speakers.

The details of the connections are as follows. Each speaker is connected via a ¼ inch audio cable to a synthesizer that will contain the forty different vocal tracks. The

[6] Monster Pro Audio, 25 April 2006 <www.monstercable.com>.

speakers are also connected to surge protectors using power cords. The five surge protectors can then be plugged directly into the walls. Thus, six electrical outlets are needed; five for the surge protectors and one for the synthesizer. For the octagonal and circular setups, this equipment can be placed along the wall on the main level. There are six electrical outlets along this wall. For the on stage setup, the surge protectors and synthesizers can be positioned off stage right. There are twelve electrical outlets on stage right. For keeping all of these cables under control, I recommend wrapping them around the speaker stands and then running them under a cable protector to the surge protectors and synthesizer. Cableorganizer.com offers the heavy duty Cable Guard ED 8200 which has a 7.75" x 2" channel size and is available in various lengths. I imagine two protectors would be required for the eighty cables.

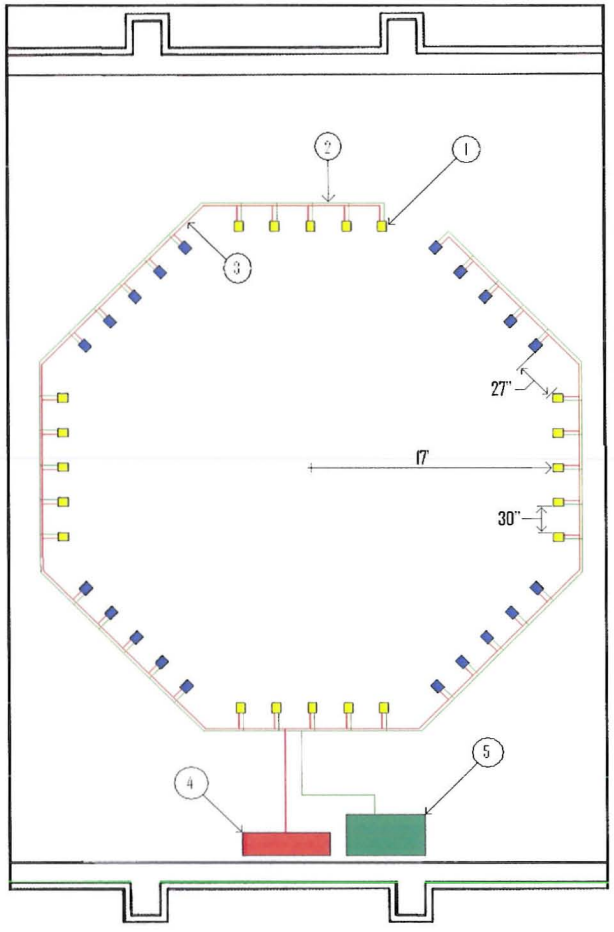
The final piece of equipment that must be considered pertains to how the listener will be physically positioned will listening to the piece. Should the listener be standing or sitting down? Should they be in the middle of the circle or offset to one side? I recommend that a simple ottoman style bench be placed in the middle of the circular and octagonal setups. This allows the listener to site directly in the center of all the sounds, and also change which direction they are facing. There is still plenty of space to walk around too and hear the music up close. Benches.com offers many simple ottoman benches, such as the Plush Bench Ottoman which would work well for this application.

Conclusion:

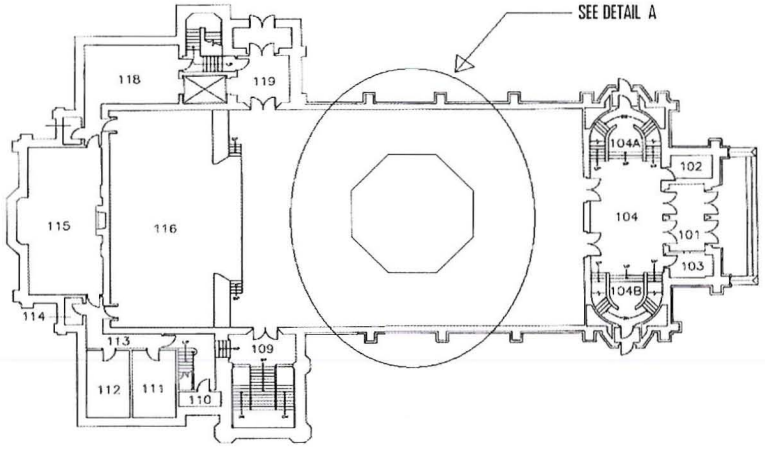
Spem In Alium is a remarkable piece of music. It conveys the classical chorale style of the renaissance period while exploring new ideas of three-dimensional sound. With this work, Thomas Tallis proved that he was one of the most visionary and creative composers of his time. Thanks to virtual choir, it is now possible to enjoy the piece in ways that even Tallis himself couldn't imagine. Although I have only discussed three possible configurations, there are literally hundreds of possible setups, each providing a fresh and exciting way of presenting the music. While there is a great deal of equipment required for such an installation, the advantages are very significant. Virtual choir can teach people about not only new music, but new ideas of how to listen to a piece. Three-dimensional music is not very common in everyday life, thus it would be very beneficial to be able to expose people to such an interesting concept. Hopefully, WPI will be able to complete this installation in the near future and teach others about the usefulness and power of virtual choir.

Appendix A:

Diagrams



DETAIL A



ITEM	DESCRIPTION	QTY
5	Synthesizer	1
4	Monster PRO 1000 Surge Protector	8
3	2500 Series Power Cable	40
2	1/4 Inch TRS Audio Cable	40
1	KRK Rokit 5	40

Note: Speakers colored yellow are at height 5'2" and speakers colored blue are at height 9'2"

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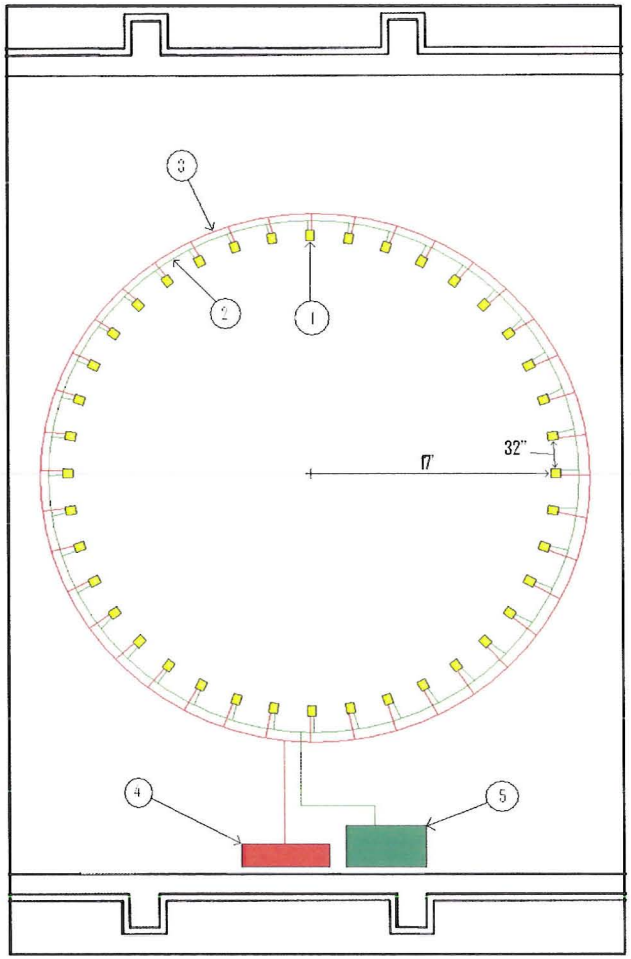
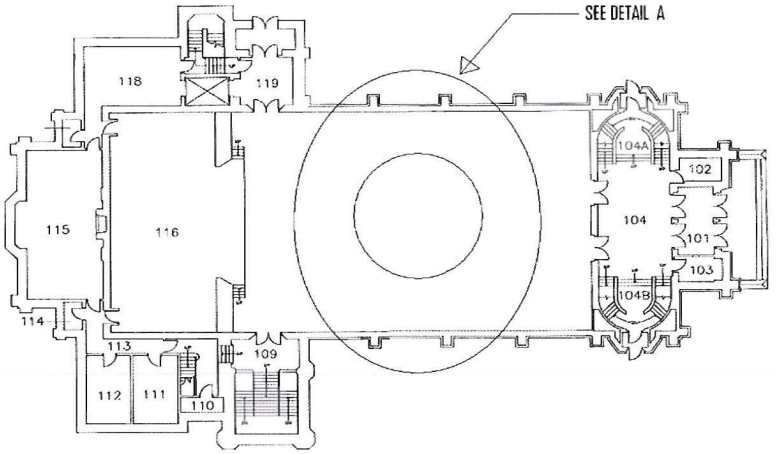
	Octagonal Configuration		
	A	Cage Code 81359	Drawing No. 1
			Sheet 1 of 1



DETAIL A

Note: All speakers are at height 5'2"



ITEM	DESCRIPTION	QTY
5	Synthesizer	1
4	Monster PRO 1000 Surge Protector	8
3	2500 Series Power Cable	40
2	1/4 Inch TRS Audio Cable	40
1	KRK Rokit 5	40

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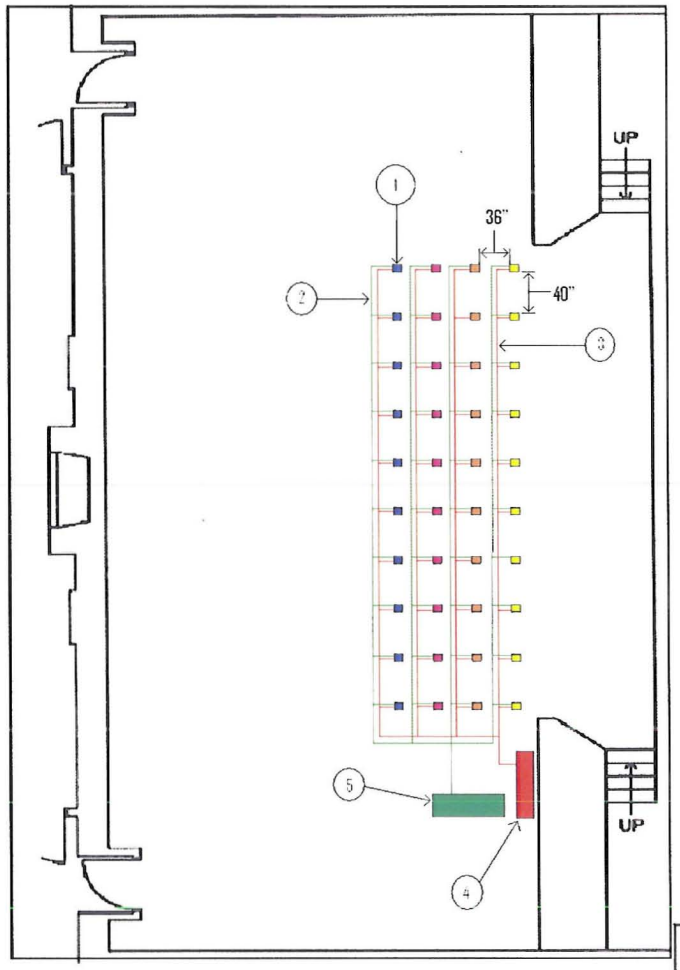
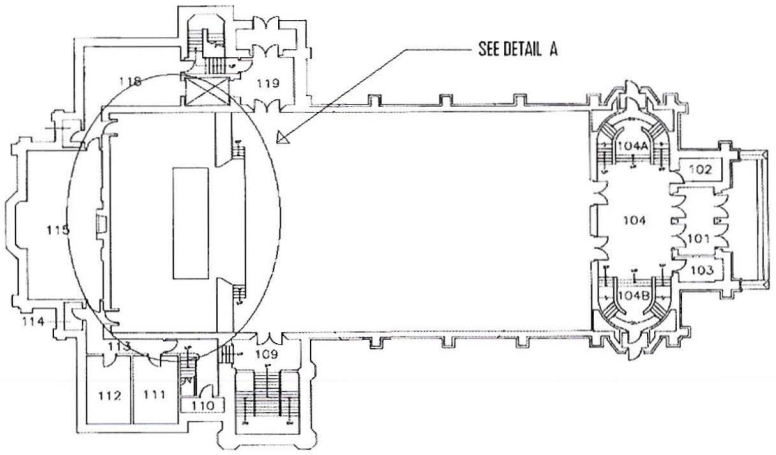
Circular Configuration

A	Cage Code 81359	Drawing No. 2

Sheet 1 of 1



DETAIL A



ITEM	DESCRIPTION	QTY
5	Synthesizer	1
4	Monster PRO 1000 Surge Protector	8
3	2500 Series Power Cable	40
2	1/4 Inch TRS Audio Cable	40
1	KRK Rokit 5	40

Note: Yellow speakers are at height 5'2", orange speakers are height 6'4", purple speakers are height 7'6", and blue speakers are heigth 9'

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On Stage Configuration

A | Cage Code 81359 | Drawing No. 3

Sheet 1 of 1

Appendix B:

Equipment Specifications and List Prices

*Note: The following information was obtained from the websites of each manufacturer.

KRK Rokit 5 Powered Studio Monitor:

Drivers:	5" woofer 1" tweeter
Input:	XLR, ¼ inch TRS, RCA
Power:	75 Watt Bi-Amplification
Frequency Range:	53 Hz – 20 kHz
Dimensions:	10.875" x 7.25" x 8.875" (H x W x D)
Weight:	16 lbs
Price:	$150
Available From:	Guitar Center, Natick

Ultimate Support Telelock TS-99 Speaker Stand:

Height Range:	5'2" – 9'2"
Weight:	8 lbs
Base Diameter:	62"
Load Capacity:	150 lbs
Price:	$110
Available From:	Guitar Center, Natick

Ultimate Support BMB 200K Large Mounting Bracket:

Dimensions of Mounting Surface:	4" x 6"
Load Capacity:	100 lbs
Price:	$21
Available From:	Guitar Center, Natick

Monster Pro Audio PRO 1000 Surge Protector:

Energy Rating:	2,775 Joules
Number of Outlets:	8
Dimensions:	4.5" x 18" x 2.5" (W x L x H)
Weight:	4.6 lbs
Cord Length:	10'
Price:	$150
Available From:	www.monstercable.com

Quail Electronics 2500 Series Three-Prong Power Cable:

Rating:	10A / 125V
Lengths:	105', 80', 70', 55', 40'
Price:	$22 – $60
Available From:	www.quail.com

Quarter-Inch TRS Audio Cable:

Lengths:	105', 80', 70', 55', 40'
Price:	$25 – $65
Available From:	www.cablestogo.com

Cableorganizer.com Cable Guard ED 8200:

Channel Dimensions:	7.75" x 2" (W x H)
Length:	20'
Price:	$250
Load Capacity:	5000 lbs
Available From:	www.cableorganizer.com

Appendix C:

Price Quote

*Note: This quote uses list prices for all products. Many manufacturers told me they could possibly offer WPI a discount due to such large quantities, thus the total price may in reality be lower.

Product	Quantity	Unit Price	Total
KRK Rokit 5	40	$150	$6,000
Ultimate Support Telelock TS-99	40	$110	$4,400
Ultimate Support BMB 200K	40	$21	$840
Monster Pro Audio PRO 1000	5	$150	$750
2500 Series Power Cable			
105'	5	$60	$300
80'	10	$48	$480
70'	10	$41	$410
55'	10	$30	$300
40'	5	$22	$110
¼ Inch TRS Audio Cable			
105'	5	$65	$325
80'	10	$50	$500
70'	10	$45	$450
55'	10	$35	$350
40'	5	$25	$125
Cable Protector	2	$250	$500
Ottoman Bench	1	$330	$330
		Grand Total	$16,170

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