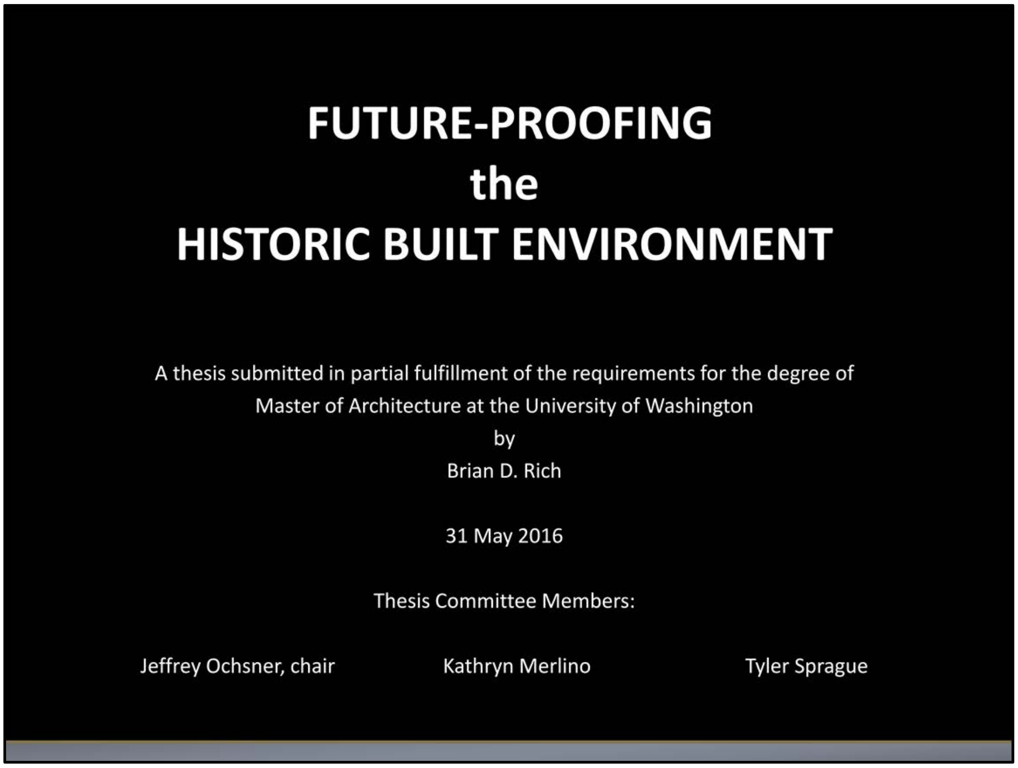


Thanks (to introducer). I'd also like to thank my three thesis committee members
.
Kathryn Rodgers Merlino – a long time friend and professor who served on the King County Landmarks with me – for first suggesting the topic of future-proofing, and
.
Jeffrey Ochsner – who has guided my development of the concept through early class and has been generous enough to chair my thesis committee
.
To Tyler Sprague who has been a stalwart supporter and critic as well as a friend while we served on the APT Northwest Board.
.
Thanks also to my classmates and final reviewers for your thoughts and critique of my work.
.
But most of all, thanks to my wife and my son for giving me the time and space to pursue my Master's degree.
.
.
I believe that "a building lived in, is a building loved, is a building lasting," a saying I developed a couple years ago. Buildings that are not used are neglected and fall into further and further deteriorated states, eventually resulting in the loss of the building, the resource, and the heritage.
.

There are systems such as LEED and RELi to rate the success of new construction. But there is no comprehensive set of principles guiding rehabilitation of historic buildings for long term use. Nor is there a system for evaluating THE ABILITY of buildings to be used far into the future.

.

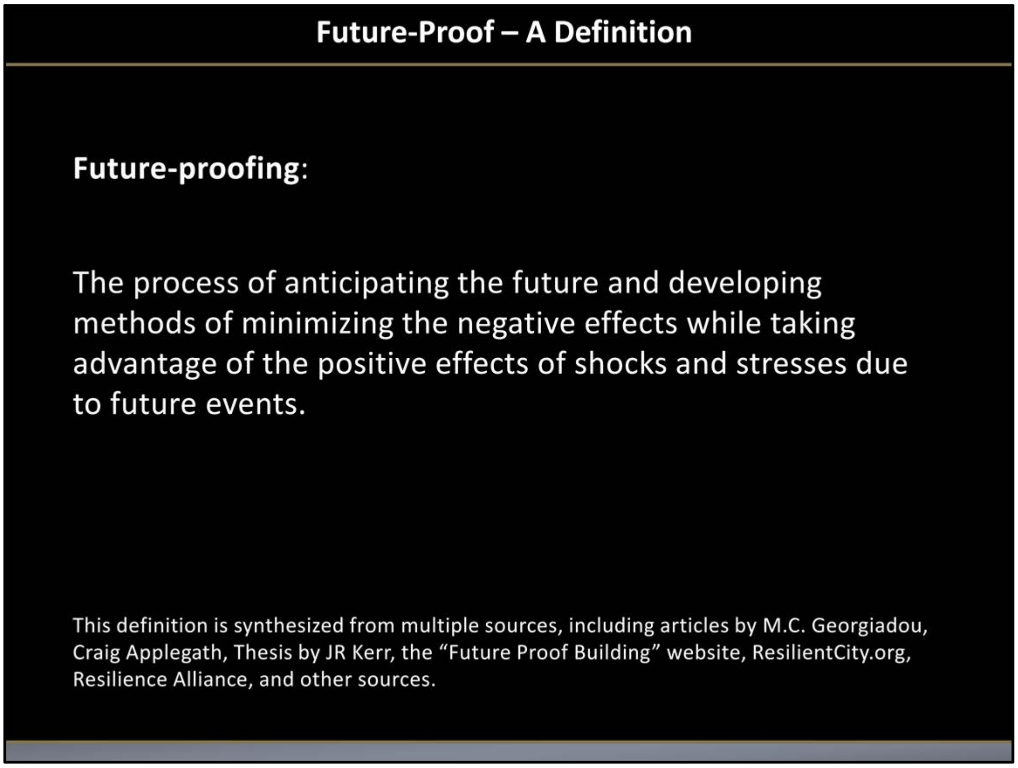
I have been conducting this research with the goal of encouraging ongoing use and management of our historic built environment.
To live in it… To love it… And make it last.

Presentation Outline

Figure 1: The 1869 Belvedere Castle by Calvert Vaux in Central Park is obsolete, but timeless and holds our interest. Credit: Brian Rich, 2013

1. Introduction
2. Future-Proofing – A Definition
3. Future-proofing Applied to Historic Buildings
4. Initial Investigation
5. How Future-Proofing Works on a Larger Scale
6. A Rating System
7. Case Studies
8. Conclusion
9. Future Research

In this presentation, I'll start by introducing a definition of future-proofing.
.
Next, I'll show how it applies to buildings and was developed into a set of Principles.
.
I will talk about it's relevance to historic buildings and a rating system.
.
Take you through some case studies and their conclusions.
.
And, last, I will share some potential areas of future research and questions that we might discuss.



To start, let me define future-proofing and share some of its origins.
.
I developed this definition based on an extensive literature review of the term "future-proof."
.
Future-proofing is the process of anticipating the future and developing methods of minimizing the negative effects while taking advantage of the positive effects of shocks and stresses due to future events.
.
It is a concept found in many industries, including:
- Electronics
- Industrial Design
- Climate Change
- Sustainable Design
- Real Estate
- Infrastructure Systems
.
These use of the term "future-proofing" in several industries forms a body of knowledge about what people mean by the concept. From this, we can derive general principles that can be applied to historic buildings.
.
Let's see what future-proofing means in these other industries and what we can draw out of them.

Selected Future-Proof Attributes

Figure 2: The collapsed I-5 bridge at the Skagit River was "functionally obsolete." Credit: http://en.wikipedia.org/wiki/File:05-23-13_Skagit_Bridge_Collapse.jpg

- Flexible
- Reusable
- Expandable
- Not obsolete
- Durable materials
- Able to withstand impacts
- Adaptability
- Built to last
- Forward / long-range planning

Here you see some of the attributes of future-proofing that come from my literature review.

.

The articles I reviewed each made clear connections between these terms and "future-proof"

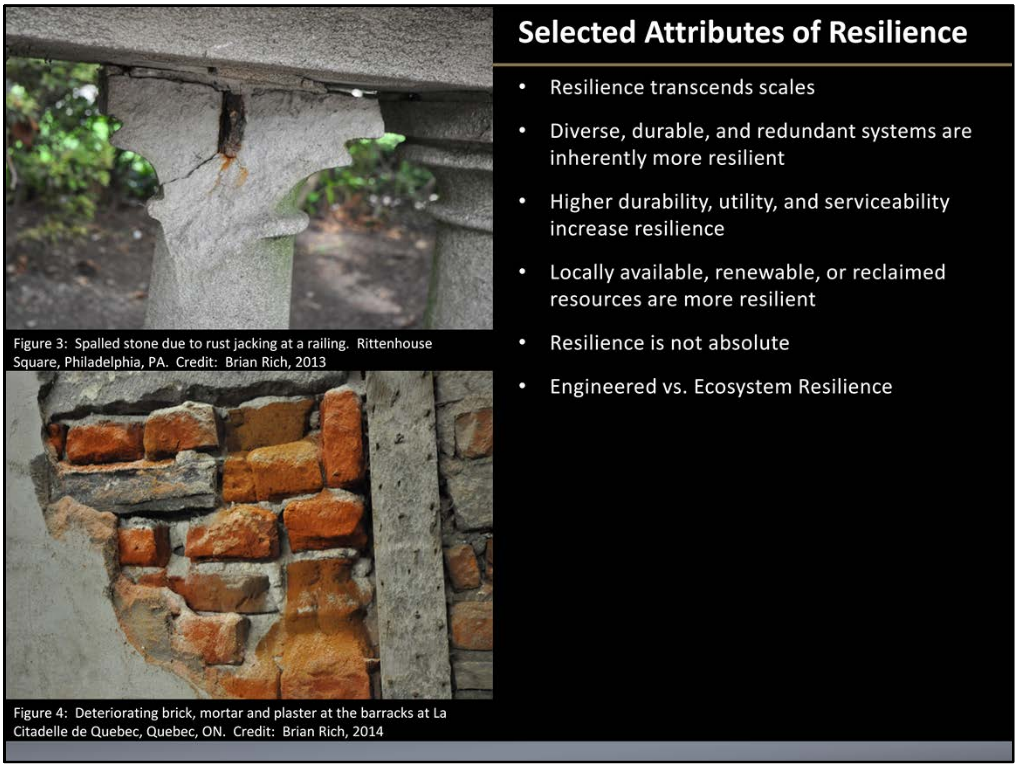


Figure 3: Spalled stone due to rust jacking at a railing. Rittenhouse Square, Philadelphia, PA. Credit: Brian Rich, 2013

Figure 4: Deteriorating brick, mortar and plaster at the barracks at La Citadelle de Quebec, Quebec, ON. Credit: Brian Rich, 2014

Resilience is a concept closely related to future-proofing. Here are a few of the basic attributes of resilient design.

.

To explore resilience further, I accepted an invitation to the AIA Resilience Summit last year. I found that the discussion focused on resilience relative to natural hazards and sustainable design.

.

While not as broad as the concept of future-proofing, and not specifically developed for application to the built environment, it does offer valuable concepts.

.

I believe that the difference between Engineered and Ecosystem Resilience is important.

.

“Engineered resilience” is the ability to resist disturbance and maintain equilibrium. Like a building structure which is designed to resist earthquakes.

.

“Ecosystem resilience” is the ability to absorb change and find a new equilibrium state. Like in ecological systems, such as a pond or stream, as they adjust and find a new equilibrium after changes in the system occur.

.

It is the potential for destructive change that we seek to moderate with “engineered” resilience.

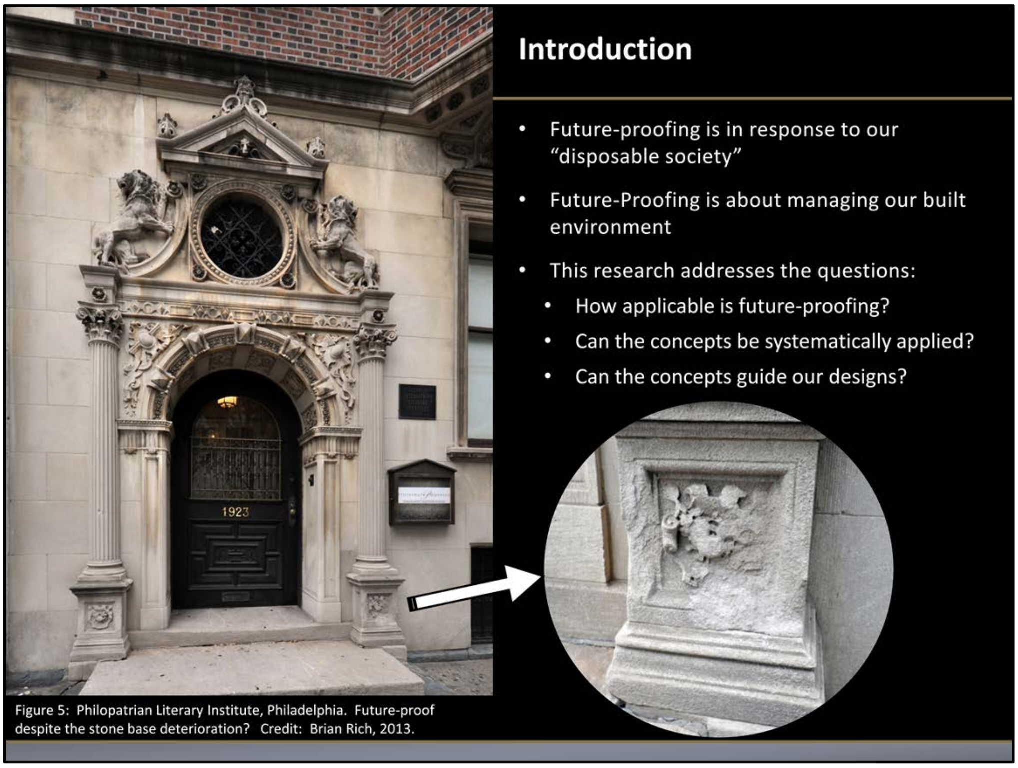


Figure 5: Philopatrian Literary Institute, Philadelphia. Future-proof despite the stone base deterioration? Credit: Brian Rich, 2013.

Future-proofing is developed in response to the entrenched and ingrained view of a "disposable society."

.

It is also in response to the numerous problems that we have built into our environment – whether unknown, ill-considered, or intentional. Future-proofing is rooted in the belief that we can manage our built environment better while respecting both preservation and progress.

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In this research, I address the questions:

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How applicable is Future-Proofing?

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Can the concepts be systematically applied?

.

Can the concepts be used to guide our designs?

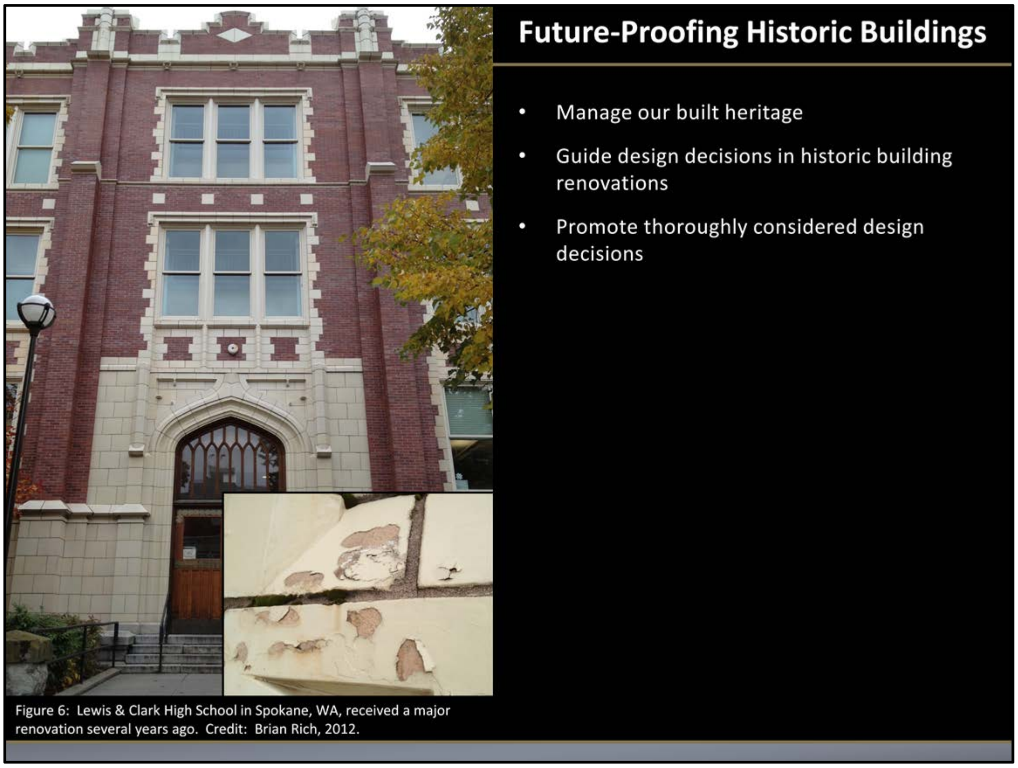

Figure 6: Lewis & Clark High School in Spokane, WA, received a major renovation several years ago. Credit: Brian Rich, 2012.

What does future-proofing mean when it is applied to historic buildings?
.
The problem is that too often, structures fail or are demolished because they don't meet current "needs." This has become more frequent as there has been an increasing focus on purpose-built structures, maximizing efficiency of structure and space, continuing pressure to deliver more space for less money, and increased deferred maintenance.
.
For example, the high school shown here received a recent renovation. But something went wrong, and the glazing on the terra cotta started spalling within a few years. This will result in the need to replace priceless historic fabric in a later project.
.
When applied to historic buildings, Future-Proofing means the careful consideration of any intervention to extend the long term service life of the building.

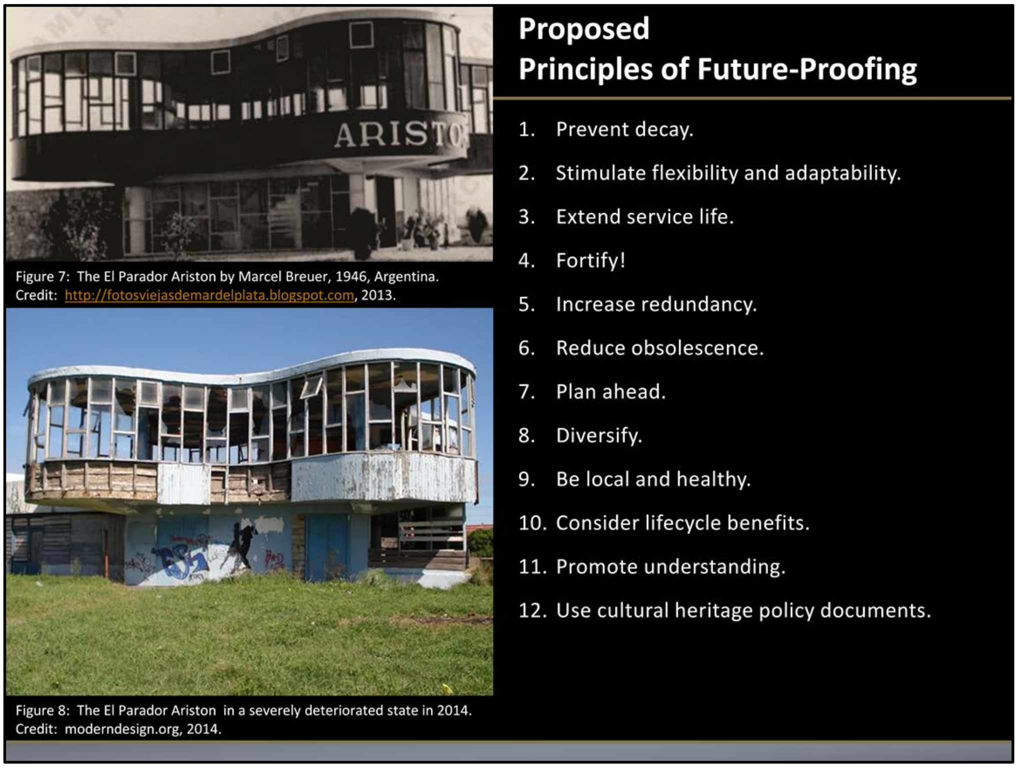

Figure 7: The El Parador Ariston by Marcel Breuer, 1946, Argentina.
Credit: http://fotosviejasdemardelplata.blogspot.com, 2013.

Figure 8: The El Parador Ariston in a severely deteriorated state in 2014.
Credit: moderndesign.org, 2014.

So how does future-proofing work on full building scale?

.

I propose the 12 Principles of Future-Proofing: derived from its use in multiple industries and blending in the concepts of resilience, sustainable design, life cycle analysis, and historic preservation.

.

It has a lot of similarities to resilient design, though the Principles are broader and focused on the built environment.

.

The list of Principles may look simple, but there is much behind these simple phrases. For instance, take Principal 1:

Figure 9: The $45 million Haludovo Palace Hotel, Krk, Croatia, 1972 was declared bankrupt in 1973 and abandoned. Credit: Nate Robert, 2013.

Example:
Principle 1 - Prevent Decay

Detailed development of this Principle includes promoting durable building materials and methods of construction that prevent premature deterioration of our built environment rather than accelerate deterioration. Interventions should use building materials of equal or greater durability than existing building fabric or design for disassembly and replacement.

Prevent Decay:

.

Detailed development of this Principle includes promoting durable building materials and methods of construction that prevent premature deterioration of our built environment rather than accelerate deterioration.

.

Interventions should use building materials of equal or greater durability than existing building fabric or design for disassembly and replacement.

.

In depth information about each Principle can be found in my thesis document.

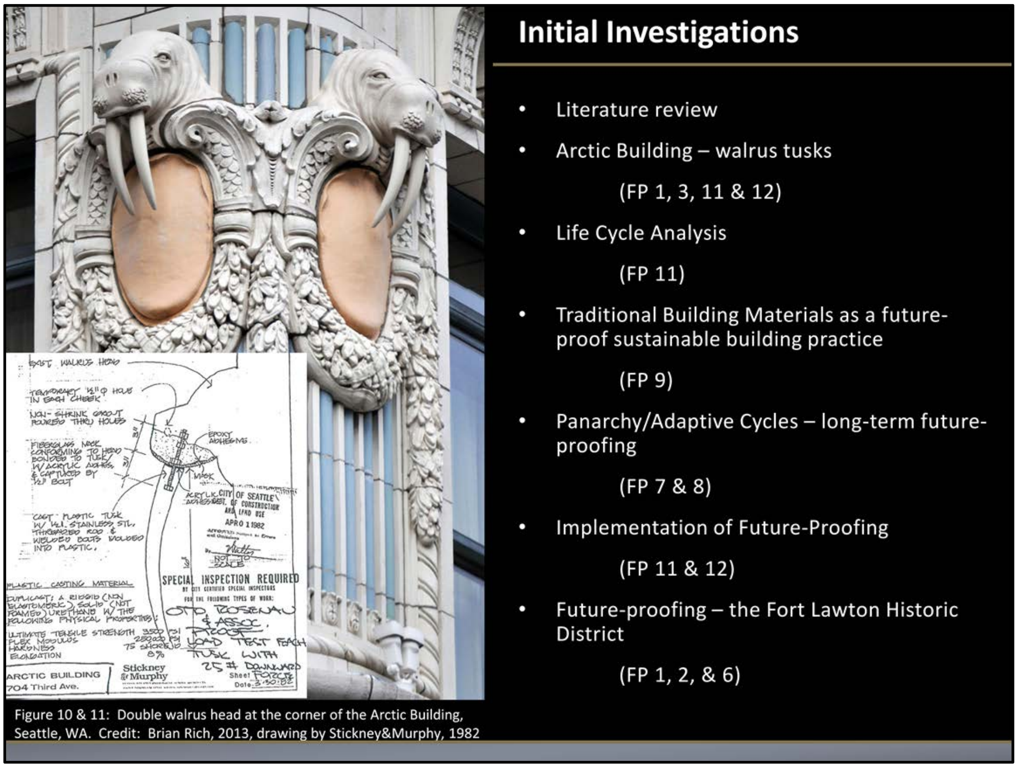

Figure 10 & 11: Double walrus head at the corner of the Arctic Building, Seattle, WA. Credit: Brian Rich, 2013, drawing by Stickney&Murphy, 1982

During my time as a student at the UW, I have had the opportunity to try out different principles and explore the meaning of future-proofing.

.

- One of those investigations was into the walrus tusks at the Arctic Building in Seattle
  - The original mild steel reinforcement for the terra cotta tusks lead to corrosion and rust jacking.
  - In a 1982 repair, stainless steel anchors replaced the mild steel
  - However, the repair made the situation worse by filling the snout cavity with a water sensitive grout and putting holes on top of the snout.
  - Ultimately, 17 of 27 walrus heads were replaced with replicas and several others repaired in a second rehabilitation in 1996.

.

- The original installation – not future-proof
- The 1982 repair – also not future-proof
- The 1996 repair – was future-proof because it eliminated all of the causes of deterioration.

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But how is future-proofing measured?

Given this set of proposed Principles and initial investigations, the question was how to apply the Principles to a project.

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There were lots of systems that didn't do what I wanted. The Principles could be used to frame the discussion, yes. However, subjective evaluation of a proposed design could create inconsistent results.

.

An absolute rating system would be more uniform and broadly applicable. The rating system proposed here grows out of the combination of multiple rating systems such as LEED, Envision, and the RELi Resilience Rating System.

.

Rather than repackage existing systems, though, 16 additional criteria have been developed to specifically address historic preservation and other aspects of future-proofing. 8 credits involve the use of the use of Secretary's Standards or other cultural heritage criteria to evaluate the proposed design. In addition, 4 new credits focusing on the construction work have been created. Last 2 credits were developed to focus on the implementation of Life Cycle Analysis.

.

Using these rating systems and the 16 new credits, 134 credits were developed. In general, each credit applies to 2 or 3 Principles. Because the 134 credits apply to more than one Principle, there are 302 total points available as you will see.

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To test this rating system, I applied it to case study projects.

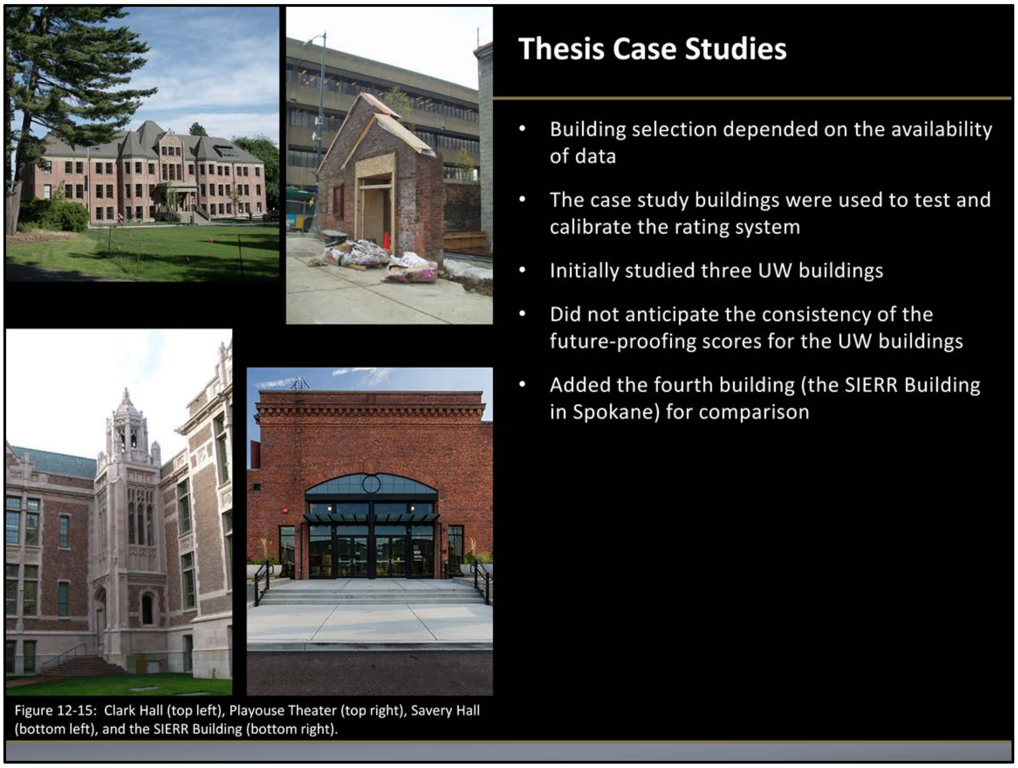

Figure 12-15: Clark Hall (top left), Playouse Theater (top right), Savery Hall (bottom left), and the SIERR Building (bottom right).

For this test, I conducted case study reviews of a total of 4 buildings:

.

From the UW, I looked for projects on the Seattle Campus, renovated in the Restore the Core Program, and which represented a variety of building types and uses. Based on these criteria, I selected Clark Hall, Playhouse Theater, and Savery Hall.

.

I also selected one building for comparison. This building needed to be off campus, have information readily available, and have been recently renovated and achieved LEED certification. The Spokane and Interurban Electric Railroad Building fit the bill.

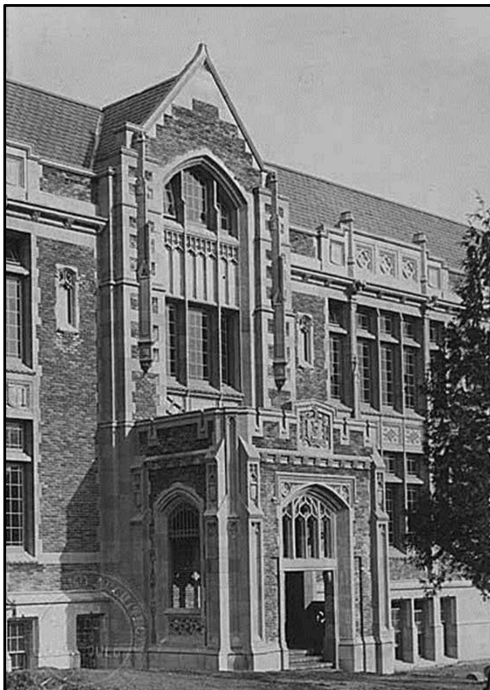

Figure 16: South entrance to Savery Hall, UW Seattle Campus, ca. 1920.
Credit: UW Special Collections, Neg. #UW6860, by A.A. Peterson.

Future-Proofing: Rating System Adjustments

- Eliminated use of the Analytic Hierarchical Process of Multi-Criteria Decision Analysis
- Considered and imposed limitations on the weighting percentages for each Principle to between 5% and 15%
- Moved the weighting of the Principles until after developing raw scores to discourage cheating by over-weighting a select number of Principles.
- Considered and rejected use of negative points for credits reviewed but not achieved

Through the course of the case studies, the rating system was adjusted to accommodate multiple different thoughts and criticisms.

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Both spreadsheet and criteria adjustments were made to refine the rating system.

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The final iteration of the rating system depicts the case study results for the 4 selected buildings.

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Next, I’ll take you through the UW Restore the Core buildings that form the basis of the first 3 case study buildings.

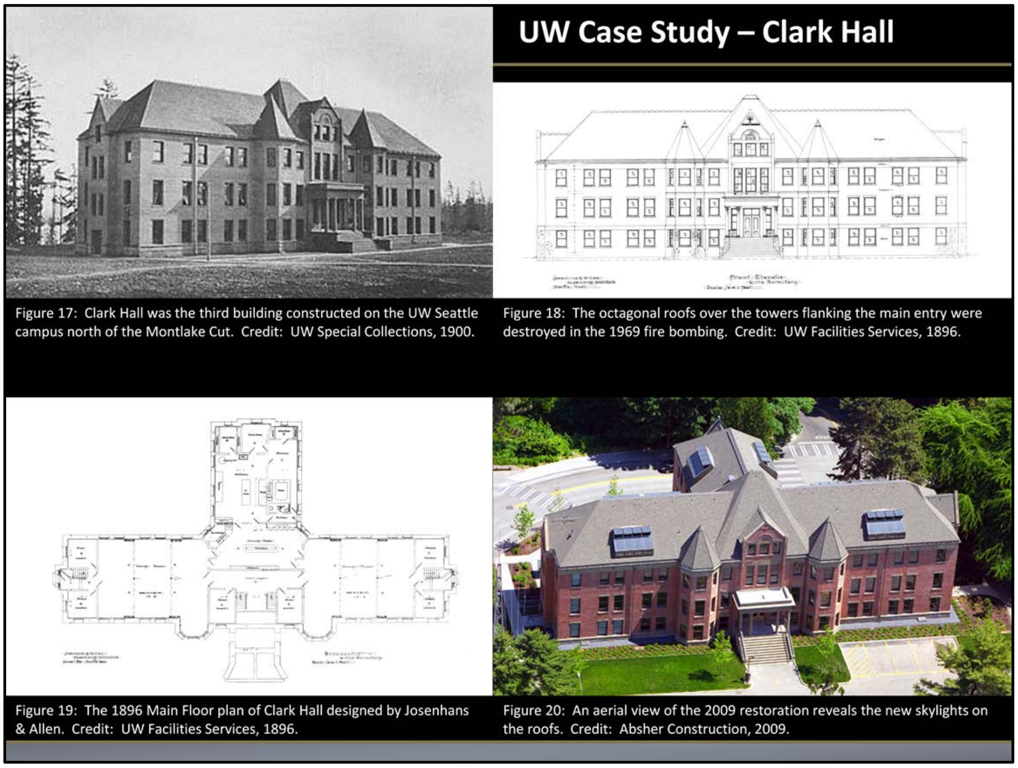

Figure 17: Clark Hall was the third building constructed on the UW Seattle campus north of the Montlake Cut. Credit: UW Special Collections, 1900.

Figure 18: The octagonal roofs over the towers flanking the main entry were destroyed in the 1969 fire bombing. Credit: UW Facilities Services, 1896.

Figure 19: The 1896 Main Floor plan of Clark Hall designed by Josenhans & Allen. Credit: UW Facilities Services, 1896.

Figure 20: An aerial view of the 2009 restoration reveals the new skylights on the roofs. Credit: Absher Construction, 2009.

I selected 3 buildings on the UW Seattle Campus that had been renovated under the Restore the Core Program between 2001 and 2009. I'll briefly describe each of the UW case study buildings and then look at the scoring for these three before going on to the fourth case study.

.

The first building selected was Clark Hall.

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Originally completed in 1896 as a women's dormitory, designed by Josenhans & Allen. The T-shaped building is built of mass masonry walls and wood interior structure with sandstone accents.

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It served as the headquarters of the ASUW, and then as the center for the ROTC programs starting in 1950. The focus of many protests during the 1960s and 1970s, it was firebombed in 1969.

.

In 2007, the Restore the Core renovation of the building was begun with a complete demolition of the interior, followed by structural seismic upgrades, and new building systems throughout.

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The exterior was restored with some minor alterations to accommodate new functions. The front portico was removed and rebuilt with glass fiber reinforced concrete.

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I'll note here that all 3 UW case studies are certified as LEED Gold projects.

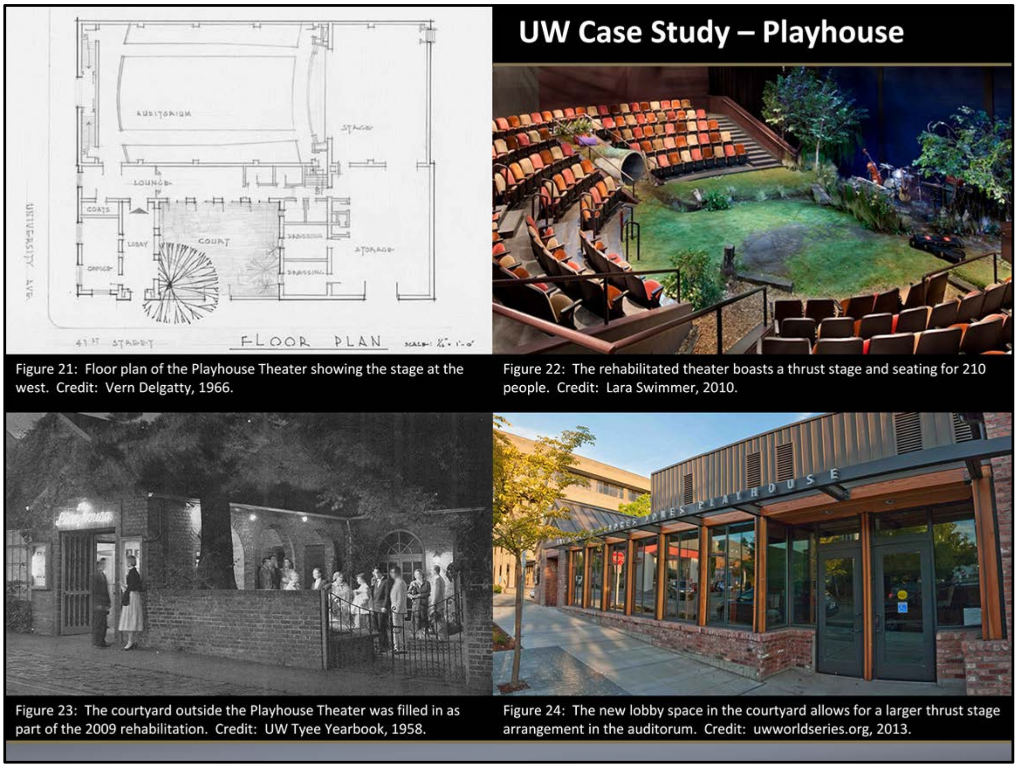

Figure 21: Floor plan of the Playhouse Theater showing the stage at the west. Credit: Vern Delgatty, 1966.

Figure 22: The rehabilitated theater boasts a thrust stage and seating for 210 people. Credit: Lara Swimmer, 2010.

Figure 23: The courtyard outside the Playhouse Theater was filled in as part of the 2009 rehabilitation. Credit: UW Tyee Yearbook, 1958.

Figure 24: The new lobby space in the courtyard allows for a larger thrust stage arrangement in the auditorum. Credit: uwworldseries.org, 2013.

The second case study building was the Playhouse Theater, off the main campus at the intersection of University Avenue and 41^{st} Street.

.

Originally a brick and tile warehouse, it was remodeled by Walter and Brady as the home of the Seattle Repertory Theater. Purchased in 1951 by the UW and remodeled in 1968, it continues to serve as the University Playhouse.

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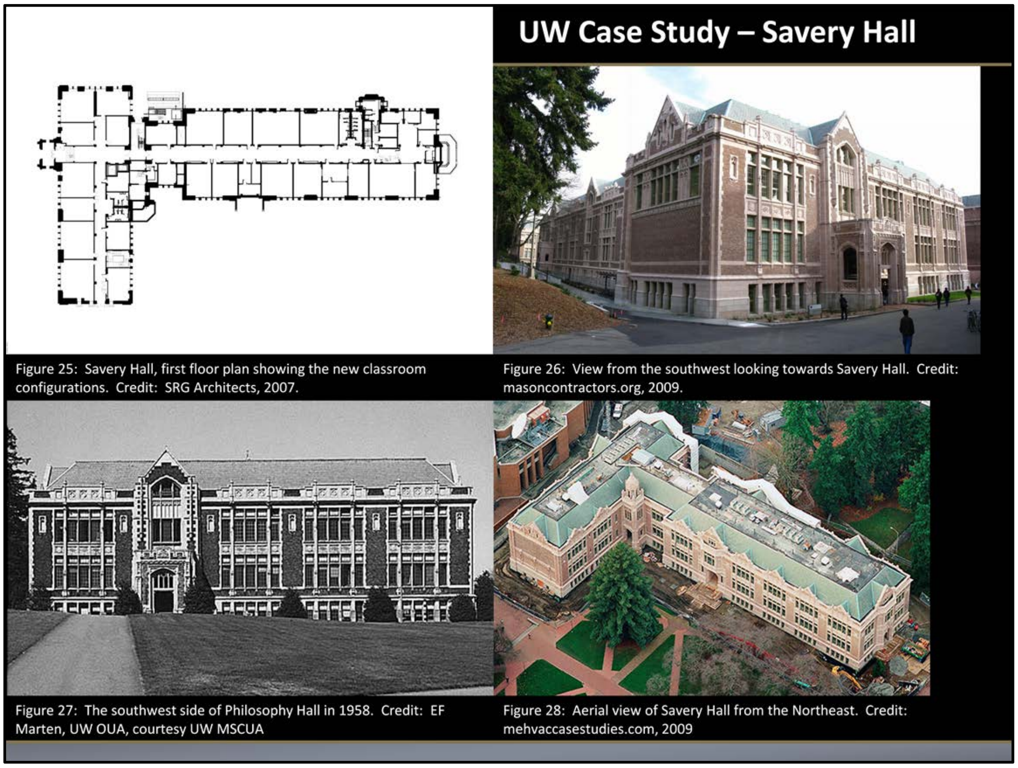
Similar to Clark Hall, the building was gutted and all new building systems were installed. Major moves involved re-orienting the stage, filling in the courtyard with new lobby space and extending upward above the existing roofline to accommodate new mechanical spaces.



The third case study building was Savery Hall.

.

Originally two buildings (Commerce Hall and Philosophy Hall), built in 1916 and 1919 respectively, they were joined in 1972 and renamed Savery Hall. The original buildings were designed by Bebb and Gould.

.

The 3 story (plus mezzanines) L shaped building used the brick and glazed terra cotta finishes that were standard for the Quad.

.

At Savery Hall, the renovation approach was again very much like Clark Hall and Playhouse Theater. The building was gutted and all new systems were installed.

.

The major moves at Savery were (1) to expand upon the mezzanine system afforded by the generous floor to floor heights in the existing building, and (2) to remove all of the exterior windows and replace them with aluminum clad wood windows.

.

Next, we'll look at the spreadsheets that show the steps in the rating system and the results for the 3 UW buildings.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Raw Scores				
	Clark	Playhouse	Savery	out of	Total
1. Prevent decay	2	2	2	out of	5
2. Flex/adapt	1	1	1	out of	6
3. Service life	8	8	8	out of	24
4. Fortify	3	2	3	out of	21
5. Redundancy	2	1	2	out of	13
6. Obsolescence	33	34	25	out of	63
7. Plan ahead	7	6	7	out of	38
8. Diversify	3	2	2	out of	17
9. Local/healthy	54	47	46	out of	76
10. LCA	8	7	9	out of	17
11. Understanding	2	0	1	out of	8
12. Policy docs	7	7	9	out of	14
Total	**130**	**117**	**115**	**out of**	**302**

Table 1: This table shows the raw scores for each of the 3 UW case study projects.

The first step in this rating system is to evaluate the project based upon the 134 criteria. As mentioned previously, it becomes clear that each of the 134 criteria contribute to more than one Principle, creating a total of 302 points maximum.

.

This spreadsheet shows the key features of the raw scores:

.

The anomalous high and low scores, highlighted in yellow, for some Principles are where the projects distinguish themselves.

.

But there was also remarkable consistency of the scoring under the other Principles, highlighted in blue.

.

Because of the consistent analysis of the results, these consistencies and anomalies carry through the remainder of the results.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Percentage Scores		
	Clark	PlayHouse	Savery
1. Prevent decay	40%	40%	40%
2. Flex/adapt	17%	17%	17%
3. Service life	33%	33%	33%
4. Fortify	14%	10%	14%
5. Redundancy	15%	8%	15%
6. Obsolescence	52%	54%	40%
7. Plan ahead	18%	16%	18%
8. Diversify	18%	12%	12%
9. Local/healthy	71%	62%	61%
10. LCA	47%	41%	53%
11. Understanding	25%	0%	13%
12. Policy docs	50%	50%	64%
Total	**43%**	**39%**	**38%**

Table 2: This table shows the raw scores converted to percentages.

This spreadsheet shows the second step where the raw scores converted into percentages for easier comparison.

.

Note the range of percentages of points successfully achieved by these projects is fairly similar with Clark Hall slightly higher than Playhouse or Savery.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Rank	Weighting
1. Prevent decay	2	10%
2. Flex/adapt	3	5%
3. Service life	1	15%
4. Fortify	3	5%
5. Redundancy	3	5%
6. Obsolescence	2	10%
7. Plan ahead	3	5%
8. Diversify	3	5%
9. Local/healthy	1	15%
10. LCA	3	5%
11. Understanding	2	10%
12. Policy docs	2	10%
Total		100%

Table 3: This table shows the ranking and adjusted weighting percentages for each of the 12 Principles which are applied to each case study

This slide shows the third step: weighting the Principles according to what Principles are considered most important for this particular project.

.

The percentage weights are manually input and can be adjusted so long as they remain between 5% and 15% and total 100%.

.

The ranking column can be used to help compare the Principles, as you'll see in the next slide.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Rank	Weighting
3. Service life	1	15%
9. Local/healthy	1	15%
1. Prevent decay	2	10%
6. Obsolescence	2	10%
11. Understanding	2	10%
12. Policy docs	2	10%
2. Flex/adapt	3	5%
4. Fortify	3	5%
5. Redundancy	3	5%
7. Plan ahead	3	5%
8. Diversify	3	5%
10. LCA	3	5%
Total		**100%**

Table 4: This table shows the rank and adjusted weighting for the 12 Principles, sorted by rank.

Here, I'm showing the rankings of the 12 Principles sorted by rank to clearly show the priorities chosen for this case study.

.

For this case study, I elected to emphasize long service life and sustainable design, Principles 3, long service life, and 9, Local and Healthy design.

.

I selected these two Principles to illustrate what happens for Principles with fewer points, such as service life, versus those with significantly more points, such as local and healthy design.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Rank	Weighting	Weighted Scores				
			Clark	Playhouse	Savery	out of	Total
1. Prevent decay	2	10%	2.0	2.0	2.0	out of	5.0
2. Flex/adapt	3	5%	0.5	0.5	0.5	out of	6.0
3. Service life	1	15%	12.2	12.2	12.2	out of	24.0
4. Fortify	3	5%	1.5	1.0	1.5	out of	21.0
5. Redundancy	3	5%	1.0	0.5	1.0	out of	13.0
6. Obsolescence	2	10%	33.7	34.7	25.5	out of	63.0
7. Plan ahead	3	5%	3.6	3.1	3.6	out of	38.0
8. Diversify	3	5%	1.5	1.0	1.0	out of	17.0
9. Local/healthy	1	15%	82.6	71.9	70.4	out of	76.0
10. LCA	3	5%	4.1	3.6	4.6	out of	17.0
11. Understanding	2	10%	2.0	0.0	1.0	out of	8.0
12. Policy docs	2	10%	7.1	7.1	9.2	out of	14.0
Total		**100%**	**152.0**	**137.7**	**132.6**	**out of**	**302.0**

Table 5: This table shows the adjusted weighted scores as well as the rank and weighting percentage applied to each of the 3 UW case study projects.

The weightings entered in step 3 are carried into step 4 and calculate weighted scores for each Principle.

.

Here in Step 4, we can compare the weighted scores for each building under each Principle.

.

But it is in the percentages that we see the impacts of the weightings most significantly.

UW Restore the Core – Case Study Results

Principles of Future-Proofing	Rank	Weighting	Weighted Percentages		
			Clark	Playhouse	Savery
1. Prevent decay	2	10%	41%	41%	41%
2. Flex/adapt	3	5%	9%	9%	9%
3. Service life	1	15%	51%	51%	51%
4. Fortify	3	5%	7%	5%	7%
5. Redundancy	3	5%	8%	4%	8%
6. Obsolescence	2	10%	53%	55%	40%
7. Plan ahead	3	5%	9%	8%	9%
8. Diversify	3	5%	9%	6%	6%
9. Local/healthy	1	15%	109%	95%	93%
10. LCA	3	5%	24%	21%	27%
11. Understanding	2	10%	26%	0%	13%
12. Policy docs	2	10%	51%	51%	66%
Total		**100%**	**50%**	**46%**	**44%**

Table 6: This table shows the adjusted weighted percentage scores for each of the 3 UW case study projects.

The last part of Step 4 is to compare the weighted scores on a percentage basis.

.

Here, you'll note that Clark Hall still retains the same percentage lead over Playhouse and Savery as in the raw score percentages.

.

In addition, you may note that the weighting of Principle 9 combined with the high raw score resulted in an unusually high percentage score.

.

This demonstrates the potential for excessive ratings and high scores that result in over-weighting of a particular Principle and justifies limiting the maximum weighting to 15%.

.

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At the conclusion of the case study of the 3 buildings on the UW campus, it was apparent to me that the systematic approach to renovations on the UW campus appears to have resulted in very consistent results.

.

This seemed highly odd given the different nature of each of each building, so I completed one further case study as a basis of comparison: the Spokane & Inland Empire Railroad Car Facility.

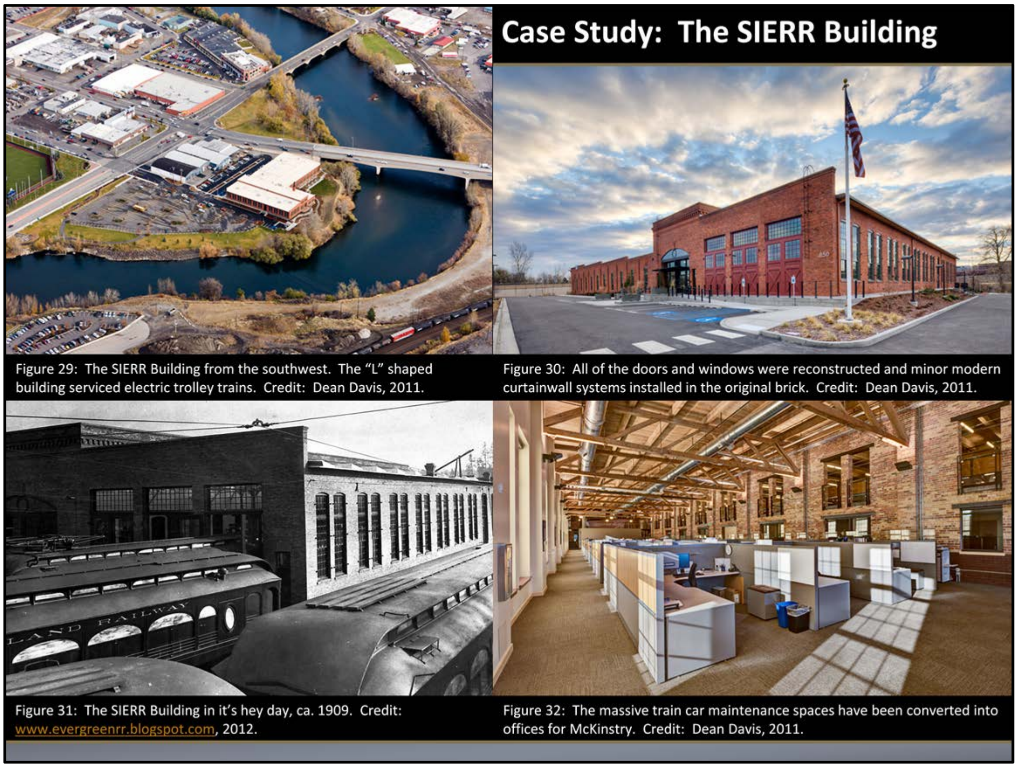

Figure 29: The SIERR Building from the southwest. The "L" shaped building serviced electric trolley trains. Credit: Dean Davis, 2011.

Figure 30: All of the doors and windows were reconstructed and minor modern curtainwall systems installed in the original brick. Credit: Dean Davis, 2011.

Figure 31: The SIERR Building in it's hey day, ca. 1909. Credit: www.evergreenrr.blogspot.com, 2012.

Figure 32: The massive train car maintenance spaces have been converted into offices for McKinstry. Credit: Dean Davis, 2011.

The Spokane & Inland Empire Railroad Car Facility, or SIERR Building, played a pivotal role in advancing the western US development of the electric interurban and city railroads, serving as the center for maintenance of electric trolley cars starting in 1907.

.

The SIERR Building was designed as an austere, industrial variation of the Romanesque Revival style complex by Albert Held, a prominent Spokane architect, and the builder was the P.L. Peterson Company."

.

By 1911, a rapid decline in electric street railways, combined with a rapid rise of the private automobile, led to the decline of the building's prominence.

.

The vast majority of the equipment and maintenance features were removed from the building prior to a 1950s conversion to trucking and warehouse uses, so much of the historic equipment and interior features are lost.

.

After the completion of LEED Gold certified renovation in 2011, the SIERR building now serves as the home office of McKinstry, an HVAC and plumbing construction company, as well as providing common spaces shared by all tenants and the Innovation Center, an accelerator for sustainable and high-tech businesses.

.

The renovation of the SIERR building was far more extensive than the three UW buildings in the sense that there was less historic fabric to retain, but also less extensive in that there was less existing building fabric to be removed.

.
The 2011 renovation of the SIERR Building deliberately focused on the long term service life of the building while still restoring the historic nature of the building, investing in improvements that would last another 100 years.
.
This had a clear impact on the future-proofing scoring as you'll see next.

SIERR Building – Case Study Results

Principles of Future-Proofing	RAW SCORES SIERR	ADJUSTED SCORES SIERR	out of	Total	Percentage Scores SIERR
1. Prevent decay	5	4	out of	5	78%
2. Flex/adapt	4	4	out of	6	60%
3. Service life	14	13	out of	24	52%
4. Fortify	5	5	out of	21	24%
5. Redundancy	6	6	out of	13	46%
6. Obsolescence	45	32	out of	63	51%
7. Plan ahead	15	14	out of	38	36%
8. Diversify	6	5	out of	17	29%
9. Local/healthy	73	51	out of	76	67%
10. LCA	13	10	out of	17	59%
11. Understanding	6	6	out of	8	75%
12. Policy docs	10	9	out of	14	63%
Total	**202**	**157**	**out of**	**302**	**52%**

Note:
LEED Version 2.1 = 69 points possible
LEED Version 2009 = 110 points possible
69/110 = 62.7%

Table 7: This table shows the raw scores, adjusted scores, and percentage scores for the Spokane and Inland Empire Railroad building.

The first thing to notice is that the raw scores for the SIERR Building are significantly higher – 202 total points versus 130 at best for Clark Hall.

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Before discussing the conclusions, I'd like to explain the remainder of the calculations.

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The higher score was largely due to the increased number of points available in LEED 2009 as compared to LEED 2.1

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For the remainder of the calculations on the SIERR building, I decreased the LEED points by reducing each LEED-based raw score by 62.7% to approximate the number of points in LEED 2.1. You can see the logic for this conversion at the bottom of the screen.

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While this is not a perfect comparison, I feel it represents a more comparable set of data.

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But why did the SIERR Building score higher?

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SIERR Building – Case Study Results

Principles of Future-Proofing	Rank	Adjusted Weighting	Adjusted Weighted Scores			Adjusted Weighted Percentages
			SIERR	out of	Total	SIERR
1. Prevent decay	2	10%	4.0	out of	5.0	79%
2. Flex/adapt	3	5%	1.9	out of	6.0	31%
3. Service life	1	15%	19.1	out of	24.0	80%
4. Fortify	3	5%	2.6	out of	21.0	12%
5. Redundancy	3	5%	3.1	out of	13.0	24%
6. Obsolescence	2	10%	32.6	out of	63.0	52%
7. Plan ahead	3	5%	6.9	out of	38.0	18%
8. Diversify	3	5%	2.5	out of	17.0	15%
9. Local/healthy	1	15%	78.1	out of	76.0	103%
10. LCA	3	5%	5.1	out of	17.0	30%
11. Understanding	2	10%	6.1	out of	8.0	77%
12. Policy docs	2	10%	9.1	out of	14.0	65%
Total		**100%**	**170.9**	**out of**	**302.0**	**57%**

Table 8: This table shows the weighting and ranks of the 12 Principles, adjusted weighted scores, and percentage scores for the Spokane and Inland Empire Railroad building.

After adjustment of the LEED scores, the process of calculating the remaining scores duplicates the process used on the UW case studies.

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Interestingly, the SIERR Building still scores much higher than the UW Restore the Core buildings. WHY?

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The strong LEED scores helped contribute to Principle 9. However, the SIERR scores were still not as strong as Clark Hall, so that's not the answer.

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As it turns out, two major things contributed broadly to higher scores: First, the design goals of making the building last for another 100 years and, second, the historic character of the project.

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This focus gained points for durability, adaptability, and flexibility and long term monitoring and maintenance under Principle 1 and 4 additional points under Principle 2. Flexibility and adaptability as well as long term durability of materials also helped gain additional points under Principle 5, 7, 8.

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However, the SIERR Building is also strong on Principal 11 and 12 due to the application of the Secretary's Standards during design review and construction. Designation and review at local, state, and national levels through the course of the project scored several points.

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The careful restoration of the building and historic character of the area also boosted the points scored under Principle 4.

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Having completed the 4 case studies, I saw the consistency of the results of the UW buildings contrasted with the success of the SIERR building. I had adjusted the rating system and the way it was applied.

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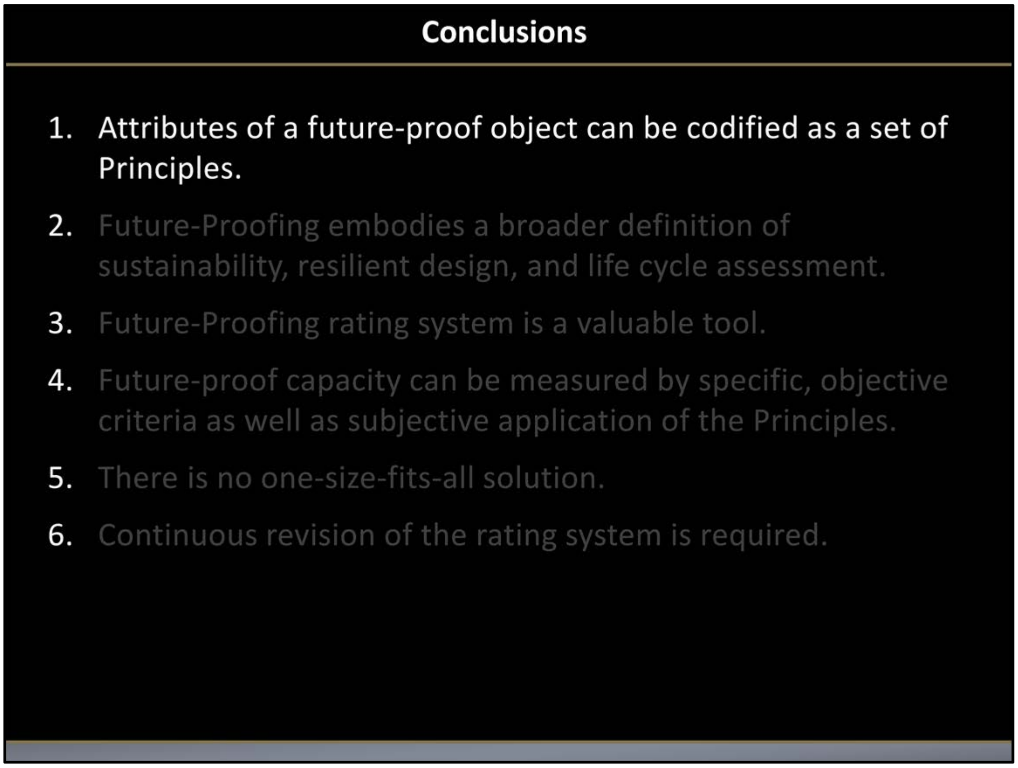
And I came to several conclusions about the Principles of Future-Proofing and the rating system.



Through this research, I've demonstrated several things:

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First, analysis of weekly Google Alerts listing articles using the term future-proof have shown continuing use of the term with consistent attributes.

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These attributes can be codified as a set of Principles to guide design.

Conclusions

1. Attributes of a future-proof object can be codified as a set of Principles.
2. Future-Proofing embodies a broader definition of sustainability, resilient design, and life cycle assessment.
3. Future-Proofing rating system is a valuable tool.
4. Future-proof capacity can be measured by specific, objective criteria as well as subjective application of the Principles.
5. There is no one-size-fits-all solution.
6. Continuous revision of the rating system is required.

Future-Proofing is valuable as a broader definition of Resilience.

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Sustainable design focuses on minimizing impacts on earth's water, air, energy, and material resources

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Popular concepts of "resilience" focuses on resistance to seismic events and climate change through an engineering resilience.

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Life Cycle Analysis focuses on the environmental impacts on the planet.

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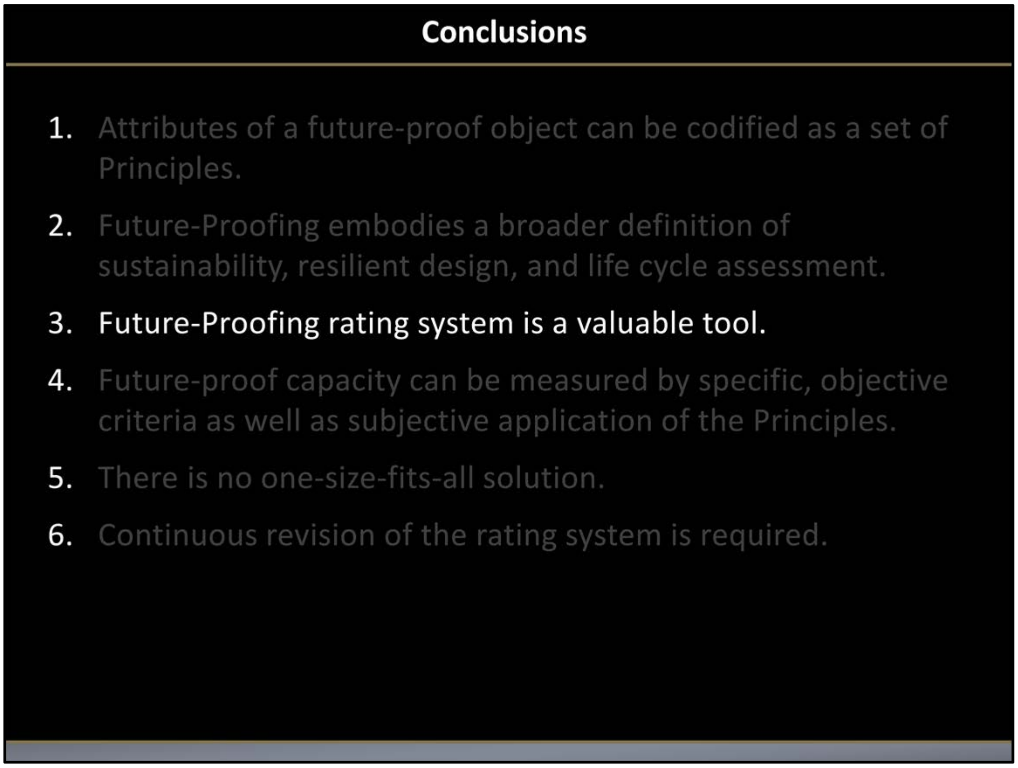
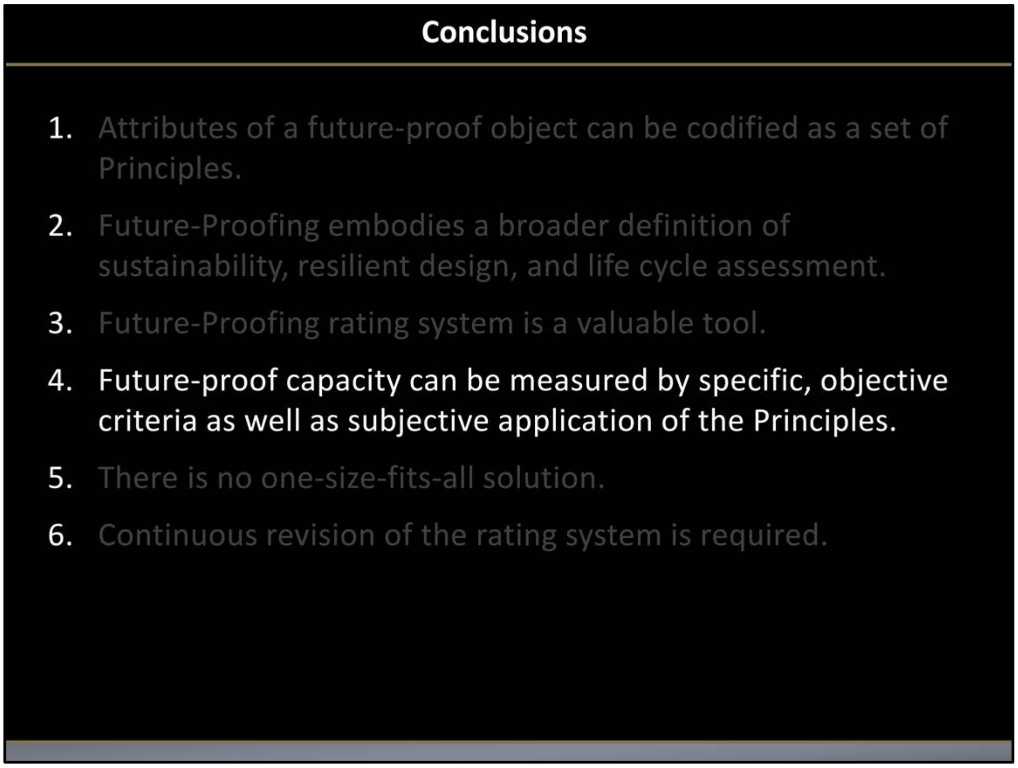
Future-proofing is the only system that combines these valuable attributes of contemporary design, but also adds other dimensions such as cultural heritage to arrive at a system for holistic management of our built environment as a resource rather than a commodity.



The rating system is a tool that can convey the priorities and goals of future-proofing by valuing their achievement in each project.



The rating system can be applied to multiple projects objectively and develop numbers that can be compared between projects.

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The ability to measure future-proofing subjectively by thinking through the meaning of each principle is valuable during design phases of an intervention in an historic building.

Conclusions

1. Attributes of a future-proof object can be codified as a set of Principles.
2. Future-Proofing embodies a broader definition of sustainability, resilient design, and life cycle assessment.
3. Future-Proofing rating system is a valuable tool.
4. Future-proof capacity can be measured by specific, objective criteria as well as subjective application of the Principles.
5. There is no one-size-fits-all solution.
6. Continuous revision of the rating system is required.

Future-proofing is designed to be a flexible system that can be applied to different types of buildings in different regions and climates and accommodate different design goals for each project.

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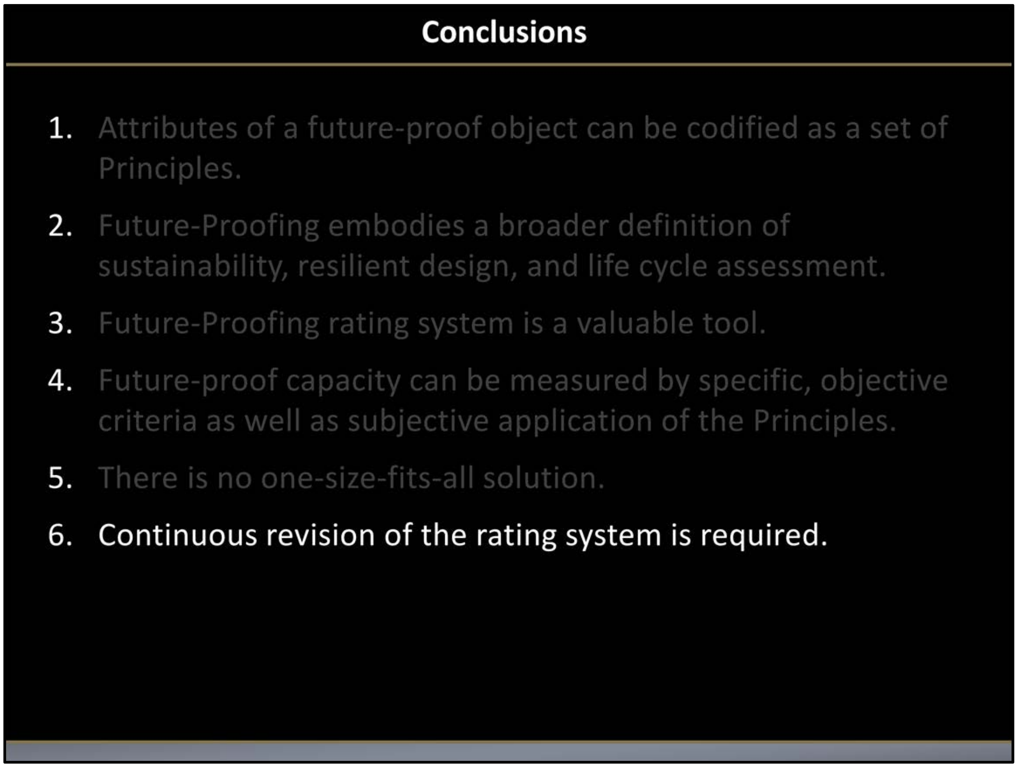
There are multiple ways to create and manage a future-proof built environment and this rating system allows for accommodation of those differnces.



Last, I found that continuous updating of the system would be required to prevent obsolescence of the system because the rating systems it is based on are continually changing.

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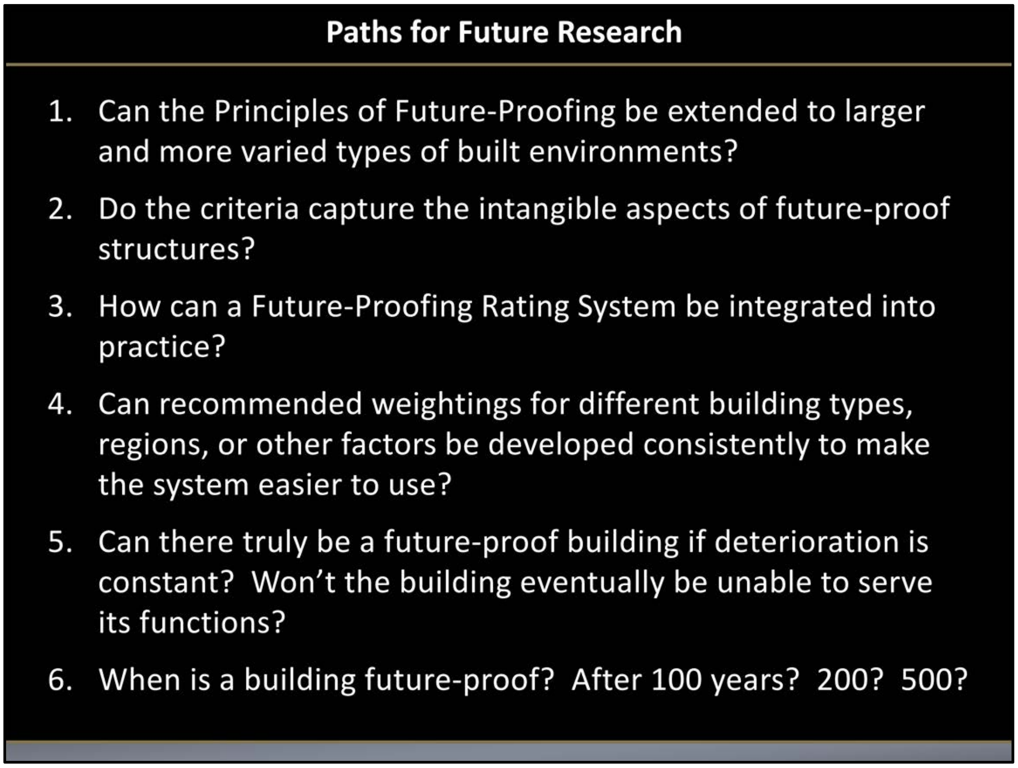
As is often the case, more questions developed as I got deeper into the research.



I'd like to highlight a few of the questions here:

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1. Can the Principles of Future-Proofing be extended from existing and historic buildings to new construction? Urban and regional scale built environments? Infrastructure systems? Or perhaps even landscapes? What about other industries or other man-made products?

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2. How can the criteria for future-proofing be improved upon? I'm not at all certain that the criteria incorporated in this rating system capture the possible ways in which a man-made object can be future-proof. There are spreadsheet refinements that can be implemented as well.

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4. Perhaps like LEED, there are several versions of the system that focus on specific industries, locations, or building types. These versions could come with recommended weightings.

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Last, there are more questions to consider about the nature of future-proofing. These questions may center around care and stewardship of our historic built environment. Which is, after all, the intent of future-proofing.

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Thanks for taking the time to consider my research. These are some questions that I believe are important to further development of future-proofing. It's been an interesting process to develop the concept, the principles, and the rating system for future-proofing historic buildings. I'm looking forward to our discussion.

End

Thanks!

The Proposed 12 Principles of Future-Proofing

1. **Prevent decay.**
   Promote durable building materials and methods of construction that prevent premature deterioration of our built environment rather than accelerate deterioration. Interventions should use building materials of equal or greater durability than existing building fabric or design for disassembly and replacement.
2. **Stimulate flexibility and adaptability.**
   Flexibility and adaptability of our built environment and our attitudes toward it are essential to retention of our built environment in a disposable society.
3. **Extend service life.**
   Extend the service life of our built environment through regular inspections and maintenance so it may continue to contribute to our economy, culture, and sustainable society.
4. **Fortify!**
   Build engineered resilience by fortifying our built environment against climate change, extreme weather and natural hazards, and shortages of materials and energy.
5. **Increase redundancy.**
   Redundant systems provide backup in the event that a primary system fails and allow a building to continue to function.
6. **Reduce obsolescence**
   Don't accept planned obsolescence. Take a proactive approach to preventing physical, functional, aesthetic, and sustainable obsolescence.
7. **Plan Ahead.**
   Prevent demolition of existing building fabric by using optimum materials, construction phasing, and scalability through long range planning.
8. **Diversify.**
   Allow for multiple stable states, like ecologically resilient systems. Include different sources, uses, capabilities, and economic models rather than one dominant trait.
9. **Be local and healthy.**
   Incorporate non-toxic, renewable, local materials, parts, and labor into our built environment to ensure materials and manufacturing capabilities will be readily available in the future for efficient repairs.
10. **Consider life cycle benefits.**
    Consider the long-term life cycle benefits of interventions in our built environment as opposed to demolition and disposal of existing historic building fabric.
11. **Take advantage of cultural heritage policy documents.**
    Typically applied during the design phases of a project, cultural heritage policy documents provide excellent guidance for the long-term retention of an historic building.
12. **Promote understanding.**
    Renovation, rehabilitation and other types of alterations to existing buildings should allow for understanding of the built environment and its place in our built heritage through minimal interventions that remain distinguishable from the original structure. Construction should respect historic fabric and seek to protect it.