GORDIAN®

A National Study of Capital Infrastructure at Schools of Agriculture:

A 2020 Update

Produced by Gordian (*formerly Sightlines LLC*)

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Foreword: An update to the 2015 Study

In the five years since the first nationwide study of infrastructure and deferred maintenance at schools of agriculture across the nation was completed, the topic of managing deferred maintenance has become an everyday conversation for many campus administrators. We continue to hear faculty stories of situations where deterioration of facilities interrupts the pursuit of the research or education mission. During the 2015 study, Gordian (formerly Sightlines LLC) identified approximately $8.4 billion in infrastructure and deferred maintenance needs across more than 90 institutions[1]. This need was concluded to be the result of an aging portfolio of facilities, many of which were constructed at a time of lower quality construction standards, coupled with an under-investment of resources into renewal and repair of existing facilities. The study identified several strategies that, if implemented, would start the slow progress of turning around the deferred maintenance problem. These strategies ranged from increasing funding from federal and state governments to encouraging individual campuses to consider how they are prioritizing investments. Despite many efforts to implement some of these strategies, one thing is clear: the deferred maintenance problem increased in severity over the last five years.

The effort to update the study for 2020 was driven in part by the desire to understand how the deferred maintenance issue has changed over the last 5 years. It is also crucial to continuing to highlight the importance of investments into capital infrastructure as a requirement to positioning our world-class schools of agriculture to confront the challenges we face as a society today.

Douglas l. Steele, PhD

Vice President Food, Agriculture and Natural Resources

Association of Public and Land-grant Universities

[1] Responding institutions include 3 types of land-grant university and colleges (1862, 1890, and 1994) and other non-land-grant universities.

Section 1: Introduction

Why study deferred maintenance at schools of agriculture?

It is hard to understate the importance of agriculture and agriculture related activities to the prosperity and well-being of the United States. In 2017, agriculture and related industries contributed over $1 trillion to U.S. GDP or 5.4% of total GDP[2]. Our agriculture industry is responsible for 22 million jobs or 11% of U.S. employment[3]. Also true is that food accounts for 13% of the average American households' expenditure in 2018, which is only behind housing and transportation[4]. With the challenges society faces today, including climate change and economic disruption, access to affordable and safe food has been and continues to be a key priority for our country. Our agriculture industry has managed to rise to this challenge and increased productivity consistently over the years[5].

The continued success in increasing productivity of our agriculture industries can be attributed in large part to the advancements made in the research, education, and extension activities occurring at schools of agriculture throughout the United States. The National Institute of Food and Agriculture (NIFA), created by the 2008 Farm Bill and authorized to continue activities through 2023 by the 2018 Farm Bill, provides funding and grant programs for these activities in the amount of $1.5 billion annually[6].

This commitment is acknowledgement of the grand challenges that schools of agriculture are focused on addressing. These include food security and safety, climate variability and change, water availability and quality, the creation of a thriving bioeconomy (bioenergy and bio-based products), and combatting childhood obesity. Addressing these challenges will require breakthrough research in many areas, including plant and animal genetics, invasive pest and disease control, natural resource management, and food nutrition. While research will provide answers to the complex issues today, schools of agriculture must also train the next generation of scientists, producers and educators to tackle the

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[2] https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/
[3] https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/
[4] https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/
[5] https://www.ers.usda.gov/data-products/agricultural-productivity-in-the-us/agricultural-productivity-in-the-us/#National%20Tables
[6] https://nifa.usda.gov/sites/default/files/resource/NIFA-2018-Annual-Report.pdf

challenges of the future. And finally, all the knowledge gained through research and education activities must be put in the hands of the people who need it most, through effective extension programs. With such important work to be done and substantial taxpayer money supporting it, the issue of deferred maintenance at schools of agriculture exists as an impediment to successfully meeting these mission mandates.

As researchers and educators try to perform 21st century science in facilities constructed in the 1950s and 1960s, facilities that have not received substantial capital infrastructure investments, they will likely encounter more roofs that leak, HVAC systems that fail, laboratories that deteriorate, animal care that is compromised, and an impacted user experience for building occupants.

The rising demand for capital infrastructure investment

Gordian's work with Higher Education institutions across the U.S. and Canada has identified several factors which, when combined, are projecting a substantial risk to growing backlog of deferred maintenance and infrastructure investments from the already elevated levels seen today. The following key drivers of deferred maintenance explain both the current backlog of deferred maintenance and capital infrastructure, and the risk that this will substantially increase in the future.

Age distribution of campus facilities. Our research has identified that there are specific points in time when a building's core mechanical, exterior, and interior systems reach the end of their useful life and must be replaced. Sometimes this means that relatively few systems come due at one time. However, as a building becomes older and multiple systems begin to reach the ends of their useful lives, all require replacement at the same time. This generally begins as a building reaches 25 years of age and accelerates once that building's age exceeds 50 years. As a greater share of space falls in the 25 to 50-year and over 50-year categories, campuses are unlikely to have the funding to address all of the systems coming

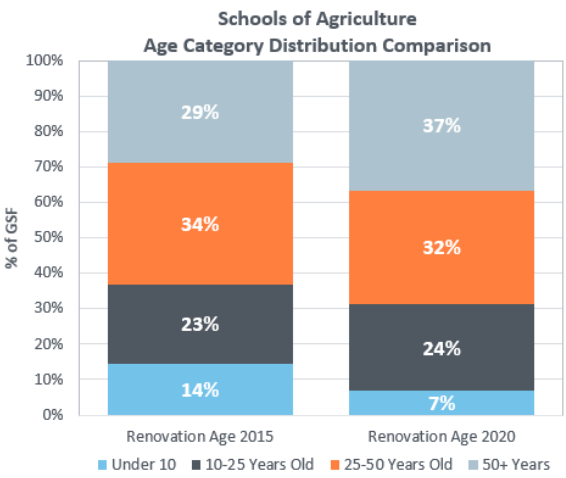

Figure 1

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due, and as a result postpone investments and defer those projects to a later date. Schools of agriculture have 69% of space over 25 years old, an increase of 6% from 2015 (Figure 1).

Underfunding of capital infrastructure investments and major renovations. When thinking about investing in campus facilities, Gordian makes a distinction between "keep-up" investments and "catch-up". "Keep-up" investments are the projects that ensure that buildings will continue to perform properly, and that systems will reach the end of their useful life. "Catch-up" investments are the major infusions of capital, typically occurring into facilities that have not received sufficient "keep-up" funding over their life, that result in a major rehabilitation or renovation to that facility. We consistently see levels of "keep-up" funding that are inadequate and declining across Higher Education, leading to an increased number of projects being deferred. In addition, other funding is frequently focused on new construction projects, rather than the major renovations or "catch-up" needs, leaving older facilities to fall into ever greater disrepair.

Competition for funding between legacy buildings and modern buildings. Higher Education has two distinct waves of building construction that have occurred over the last 150 years. The first wave, buildings built between 1950 and 1980, represent many of the legacy buildings that exist on campuses today. These facilities were constructed at a time when campuses were expanding dramatically and have played a crucial role over the last 50 years in support of key programs at each institution. However, it is true that many of these facilities are reaching the end of their useful lives and will require substantial investments to meet the current needs of their programs. The second wave, buildings built since 2000, represent high quality, but also highly complex, modern buildings. Many of these facilities were added to campuses to meet the increasing facilities demands of 21st century research. As a result, these facilities have many more components that are highly complex and expensive to replace. Within the next 5 years, these modern buildings will also cross the 25-year age mark, driving costs up as a large portion of the complex

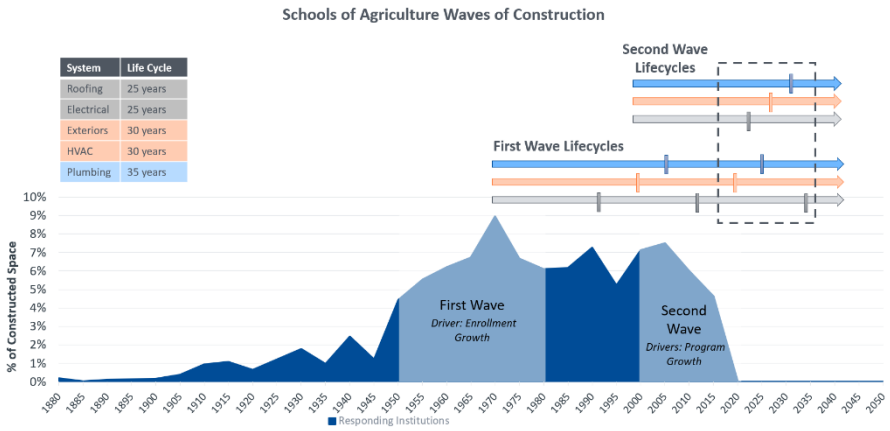

Figure 2

components come due. With both groups of buildings requiring capital investment at the same time, it is unlikely that either group will receive sufficient funding to stem the increase in deferred projects. Schools of agriculture have 40% and 18% in legacy and modern buildings respectively (Figure 2).

As the updated data for this study shows, these drivers are firmly in place across schools of agriculture in the U.S. and present the likelihood that the deferred maintenance problem risks becoming more acute over the next 10 years. Understanding the current size of the deferred maintenance problem, how it has changed, and the root causes is critical to raise awareness of the urgency of the problem and develop effective strategies to stem the growth.

Section 2: Methodology

This study includes only buildings and supporting facilities at schools of agriculture that are authorized to receive USDA funding if it were to be appropriated. Through the course of our two studies, we have collected standardized data on over 16,000 buildings and 95 million gross square feet across 97 institutions. We have compiled this information into a large database. The information collected for each facility includes size, function, technical complexity, construction year, and renovation year. Utilizing this information, we are able to estimate the level of deferred maintenance and capital infrastructure investment need. This is based off our database of deferred maintenance studies that Gordian (formerly Sightlines) has completed at more than 150 campuses. Compiling this information into a single database has allowed us to amass one of the largest databases of building level details for U.S. schools of agriculture research, classroom/teaching, and extension facilities.

Section 3: Summary of Findings

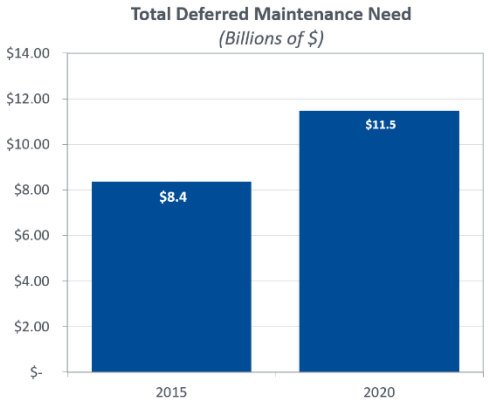

Figure 3

Our update to the total deferred maintenance figure for 2020 was determined to be almost $11.5 billion, compared to a total replacement value of the facilities surveyed of $38.1 billion. This figure represents a growth of approximately 37% from the study in 2015 (Figure 3). The growth over this 5-year period can be attributed to both the increasing cost of capital infrastructure investments (inflation) and additional projects being deferred due to the drivers discussed above. Ultimately, looking at this figure on a per gross square foot (GSF) basis allows you to compare it to industry benchmarks. At $120 per GSF, schools of agriculture have exceeded both our higher education and industry national averages (Figure 4). Additionally, we have determined that as deferred maintenance exceeds $100 per GSF, building system failures become more likely, day to day operating costs increase, and occupant experience begins to be impacted.

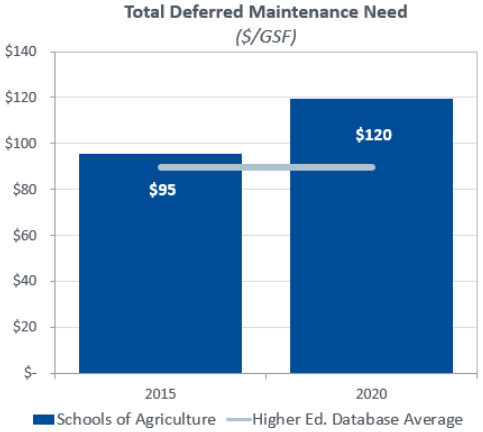

Figure 4

In considering the risk posed by high levels of deferred maintenance to the research, education and extension activities, we can differentiate between different types of spaces across schools of agriculture. The distribution of space surveyed includes 31% research space, 26% classroom/teaching space, and 4% extension space. The remaining 39% is distributed between farm, support and greenhouses. Of even greater importance is the amount of deferred maintenance occurring in those mission critical facilities. We observe that over $7.5 billion of the total identified deferred maintenance needs fall in the research, classroom/teaching, and extension space. This amounts to over 66% of deferred maintenance needs identified. This highlights that while there are a substantial number of farms, greenhouse and support facilities (39%), those facilities tend to be less complex and have a smaller share of the total deferred maintenance identified. Considering this on a per GSF basis, we see research at $142 per GSF, classroom/teaching at $120 per GSF, and

extension at $105 per GSF, well above the school of agriculture average and the national average (Figure 6). This further confirms the risk of research, classroom/teaching, and extension interruption or impacts posed by deferred maintenance.

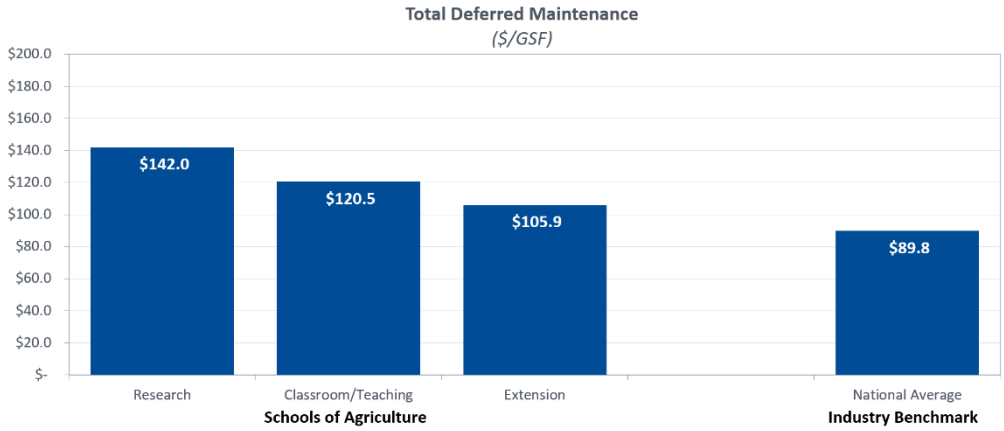

Figure 6

Section 4: Strategies for Change

As we have shown in this updated study, the deferred maintenance problem at schools of agriculture has grown in magnitude and urgency since the original study done in 2015. Despite efforts made by some to implement strategies to stem the growth of deferred maintenance, the continued aging of facilities, the lack of funding to address capital infrastructure, and the increasingly competing demands between different eras of construction have led to a 37% increase in deferred maintenance need in 5 years. Our analysis suggests the severity of the deferred maintenance problem at schools of agriculture will become more acute in the decades to follow, absent significant action from multiple entities and stakeholders.

To turn the tide on this deferred maintenance problem, the efforts pursued will have to address both the need to "catch-up" on the deferred maintenance that exists today, while simultaneously establishing an approach to "keep-up" with future capital infrastructure renewal. This balancing act can be exceptionally difficult due to the need to coordinate funding and efforts between many different institutions, administrators, agencies, and government bodies. We claimed in the 2015 report "*In past studies, Sightlines has been reluctant to say an infusion of money is the answer to the growing deferred maintenance problem in higher education. But without a major infusion of funding over time, the*

classroom, scientific research, animal care, extension and support buildings on APLU BAA campuses will face a future of:

- *Roofs that leak, foundations that crack and doors and windows that do not keep the heat in or the cold out.*
- *HVAC, electrical and plumbing systems that fail.*
- *Laboratories that cannot function.*
- *Animal care that is compromised.*
- *Health and safety problems for building occupants."*

This is as true today as it has ever been, with deferred maintenance needs having grown 37% to $11.5 billion since that first report was written.

A "Catch-up" is needed. It remains that an immediate, targeted, and substantial infusion of funding for the renewal and reinvestment of existing school of agriculture facilities is needed in order to protect the billions in research, classroom/teaching, and extension activities currently being conducted in these facilities across the country.

- The magnitude and urgency of the funding needed, along with the substantial stake held by the federal government in the work being conducted at these facilities, make the federal government a key piece in any effort that is to be successful in addressing the current problem.
- States also have a role to play in supporting the schools of agriculture in their states, as they are prime beneficiaries of the increased productivity and profitability of agriculture and agriculture related businesses in their states. A matching program between states and the federal government could present a promising approach to growing the amount of funding addressing this problem, as could making large infusions of federal government funding contingent on some ongoing state funding to support these facilities long into the future.

Campuses have a role to play in "Keep-up". While an immediate infusion of funding would have dramatic effects and create significant benefits to the institutions and communities receiving them, failure to solve the conditions that have allowed for this problem to exist will result in history repeating itself.

- Campuses need to develop long term capital infrastructure plans. These plans should provide a framework for understanding how the campus is going to set funding priorities, target major renovations over time, and determine conditions for demolition and/or divestment of existing buildings.
- Campuses need to steward new or newly renovated facilities through practicing proactive maintenance programs and establishing recurring funding sources for maintenance and repair. Our research suggests that $1 dollar spent on these types proactive practices can equate to $3-4 dollars in the future, when delayed and resulting in a failure or reactive expense.

Capital Infrastructure investment benefits the local communities. With $11 billion in potential capital infrastructure construction projects, were funding allocated to address these needs, the economic impact would extend far beyond just improving the facilities and experiences of those at the schools of agriculture. As Josh Bivens, Director of Research at the Economic Policy Institute, discusses in his report on employment multipliers for the U.S. economy, "Each industry has backward linkages to economic sectors that provide the materials needed for the industry's output, and each industry has forward linkages to the economic sectors where the industry's workers spend their income. Therefore, in addition to the jobs directly supported by an industry, a large number of indirect jobs may also be supported by that industry. The subtraction (or addition) of jobs and output in industries with strong backward and forward linkages to other economic sectors can cause large ripple effects."[7] Using

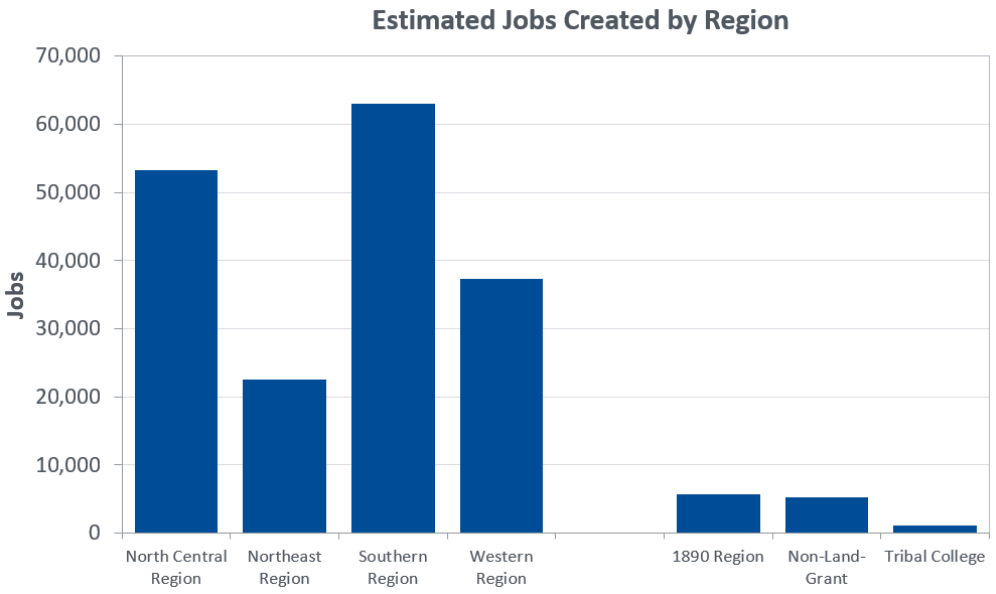

Figure 7

[7] https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/

Bivens' research, we can estimate the impact on the local job creation (both direct and indirect) that would result from funding capital infrastructure investments. It is estimated that nearly 200,000 new jobs could be created by funding the work identified in this study (Figure 7).

Due to the presence of schools of agriculture throughout the country, the distribution of their facilities across states, and the presence in both rural and urban communities, the economic impact and job creation caused by these types of investments would be broadly felt. This means that investments in capital infrastructure at schools of agriculture will not just sustain the research, education and extension activities, but can be a driver of economic growth in many communities that rely heavily on the local university, research stations, and/or extension centers as an engine for economic development.

Conclusion

The deferred maintenance problem that exists at schools of agriculture today was not created overnight or by decisions made by any one entity. It is the result of a number of driving factors, including aging buildings, scarce funding, and increasing building complexity. While this problem was not created overnight, its implications are increasingly approaching an inflection point where the detrimental impacts of deferred maintenance become a common occurrence. Over the last decade there have been several high-profile building system failures that have resulted in lost research. One notable example was a freezer malfunction (along with the 2 alarm systems that should have been triggered), which severely damaged a third of the world's largest donated brain collection for autism research[8]. It has been estimated that this loss could set autism research back by a decade or more. Given the magnitude of the societal challenges that schools of agriculture are working on, any interruption or loss of research cannot be tolerated. The window of opportunity is closing for schools of agriculture to proactively address deferred maintenance and mitigate the risk of research, education or extension interruption.

To begin reducing the deferred maintenance burden will require a coalition of efforts, pursuing multiple solutions concurrently. Inaction will not do, as it has led to the problem we face today, a problem that is projected to accelerate in its severity over the next 10 years. All levels of government, campus administrators, and any agency with a vested interest in the work being done at U.S. schools of agriculture have a role to play. By acknowledging the problem and pursuing the strategies outlined in this report, the success of our agriculture research, education, and extension activities can be preserved for generations to come.

[8] https://hms.harvard.edu/news/freezer-failure-brain-bank-hampers-autism-research