UVA IVY CORRIDOR PHASE II REDESGIN

THE FORKING PATHS: DIRECTION, FORM, AND OUTCOMES OF TRANSPORTATION INFRASTRUCTURE IN THE UNITED STATES

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Civil and Environmental Engineering

By
Noah McGhee

October 27, 2022

Technical Team Members:
Eduardo Corro
Lex Clements
Soojin Jang
Cameron Murie

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Rider Foley, Department of Engineering and Society

Teresa Culver, Department of Engineering Systems and Environment

Introduction

In the last century, transportation infrastructure in the United States has taken many forms: horse-drawn carriage, electric streetcar, elevated rail lines, superhighways, and airports. While each of these advancements increased connectivity within and between cities, they also sacrificed important pedestrian space to do so. Separate, elevated walkways and pedestrian malls have created dispersed pockets of pedestrian activity around cities that often see less activity than they were designed for (Forsyth & Southworth, 2008). The boom of family automobiles in the postwar period (1950s) corresponded with a rise in the number of sprawling suburban neighborhoods and dendritic networks of cul-de-sacs. Block sizes increased, density declined, and circuity grew until the only viable choice for moving from point A to point B was by private car – too many dead-end streets made it difficult for buses to maneuver through neighborhoods. Studies in recent years have shown connections between so-called urban sprawl and traffic fatalities, environmental quality, and physical inactivity (Boeing, 2020).

Recent projects at the University of Virginia have attempted to address some of its campus sprawl. The Brandon Avenue project seeks to increase connectivity between the upperclassmen housing at Bond and Bice Houses, the South Lawn complex, and the Academical Village. The Ivy Corridor project will fill a gap in university property between Central Grounds and North Grounds while also fulfilling the needs for more academic, residential, and dining space along Ivy Road and making progress toward the UVA Sustainability Goals (Vanasse Hangen Brustlin [VHB], 2021). Our Capstone design team has been tasked with redesigning part of the Ivy Corridor project with fewer requirements than engineering firm VHB. We will be working through each step of the design process as a simulated engineering firm to create a site that works to support the University and the community.

Understanding projects like Ivy Corridor requires an understanding of the intertwined social and technological processes occurring behind the scenes. The STS framework social shaping of technology (SST) is one method for making sense of change that tries to strike a balance between the social and the technological.

Technical Topic

The Academical Village at the University of Virginia's Central Grounds and the Professional Schools at North Grounds are separated by a small distance but connectivity between the two is extremely limited. The six-minute car drive or 30-minute walk between the two requires moving around a stretch of private businesses along Ivy Road and through the bulk of the University athletics complex. This island of private land was noted as particularly crucial to the connectivity between areas of Grounds as the Board of Visitors began planning for development. Architect for the University Alice Raucher referred to it as the "strategic connection between North Grounds and Central Grounds" and the "connective tissue" between the two regions (Anderson, 2016, p. 1). Like other projects around the university, a central focus of the Ivy Corridor work is facilitating pedestrian flow and creating an aesthetically pleasing green streetscape (Perkins+Will, 2016). The design framework for the project was approved in 2016 and construction began in the summer of 2022 for public realm work (Dodson, 2016; Kelley, 2022). To minimize construction-related delays and streamline logistics, the project was split into two phases as shown in Figure 1.

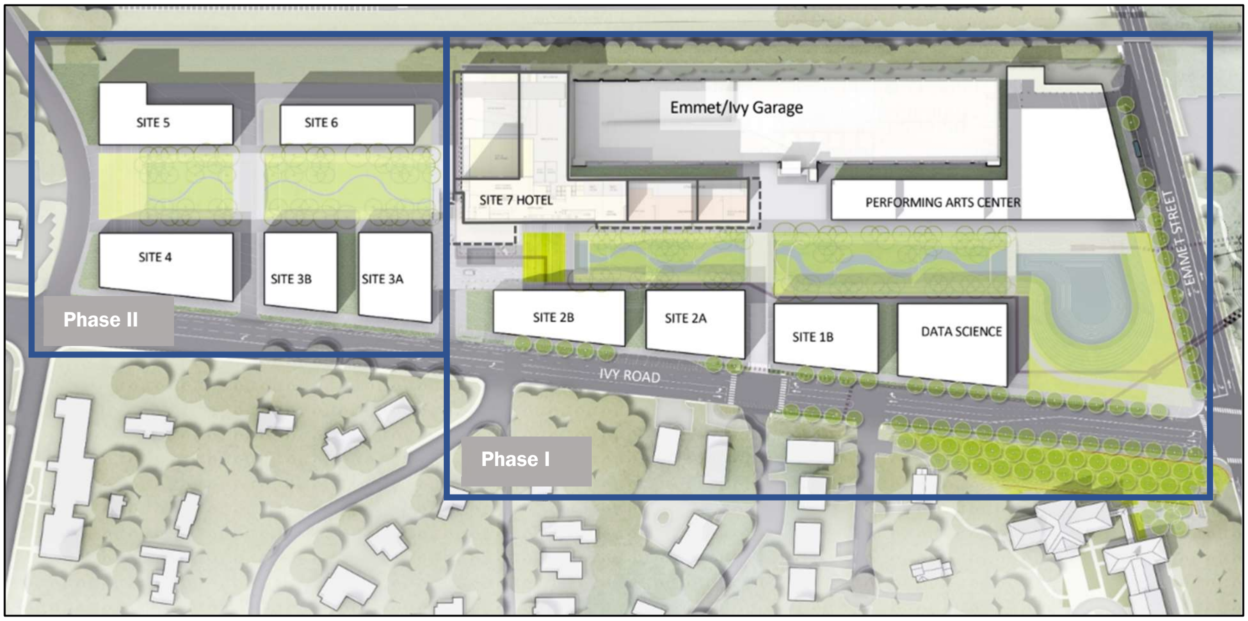

Figure 1. Full build out plan of Ivy Corridor project indicating Phase I and II locations (Image adapted from DumontJanks et al., 2016).

Our design team was asked by VHB Associates, the design engineering firm for the Ivy Corridor project, to create an alternative development plan for Phase II. Their plan creates a grid-like configuration across the site that allows for phased construction of buildings within predetermined plots (DumontJanks et al., 2016). For our project, VHB has relaxed the requirement for modularity and requested a design that meets the requirements of the university and the community while creating a more "unique" feel. In addition to the pedestrian mobility and connectivity needs described above, the design report will include multimodal access considerations, stormwater management planning and modeling, utility routing, construction scheduling, cost estimation, and qualification for accreditation through the Leadership in Energy and Environmental Design (LEED) program. Over the course of the year, we will be doing work in AutoCAD, ArcGIS, EPA Storm Water Management Model (SWMM), and other computational and modeling software as we navigate the complex needs of our site. At this point of the year, we have created a preliminary design for Phase II (Figure 2) and have started to apply the different analysis methods to assess its performance. As the design has run through these analyses, issues have arisen from the need to balance building requirements, pedestrian needs, vehicle access, and stormwater management.

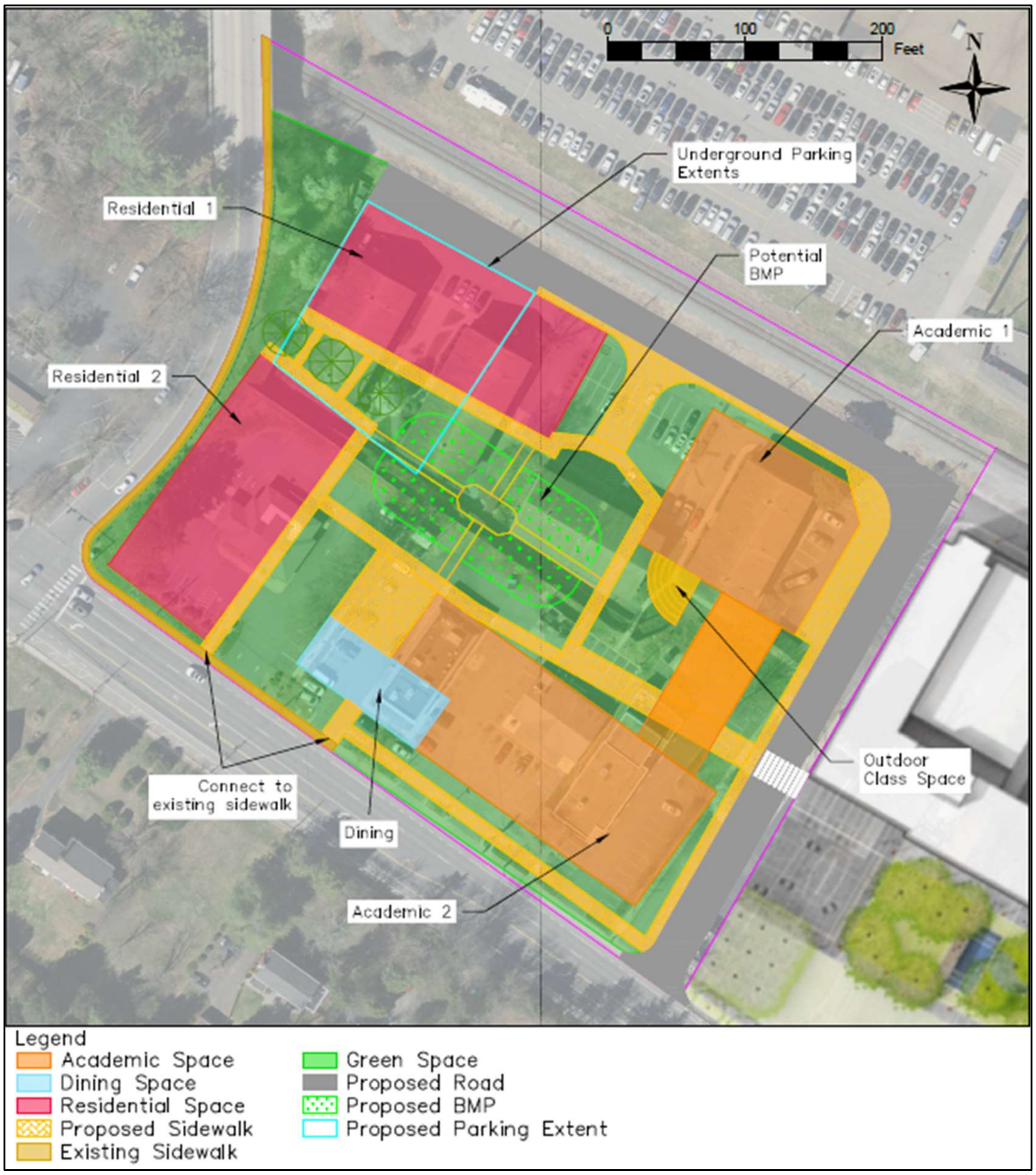

Figure 2. Preliminary design layout for Ivy Corridor Phase II. (Created by McGhee, 2022).

Pedestrian-centered design is not a scheme unique to projects on Grounds at the University of Virginia. Chicago, San Francisco, and Seattle have all experimented with the conversion of streets and parking lots to community spaces (Hammerschmidt et al., 2020). The arterial street of Strøget in Copenhagen, Denmark was converted to pedestrian-only usage in 1962 and has been followed by a network of other side streets and squares (Global Designing Cities Initiative, 2016). Across the globe, there has been a shift in urban planning toward designs that favor alternatives to motor vehicle traffic, particularly pedestrian and bicycle travel. In many cases, new pedestrian-centered developments are intended to combat the effects of suburban sprawl and draw in residents to revitalize communities. Others point to the physical and social breakup of communities by large highway projects as the motivation for change. Pedestrian improvement projects also provide environmental benefits through the diversion of vehicle emissions and greening of transportation corridors (Isaacs, 2000; Choi et al., 2016).

The Garden of Forking Paths

Many sociologists and technological historians have researched how technologies come to be "successful" and what sort of forces guide the development of technology, particularly transportation systems. Some have argued that either technological determinism or social construction of technological (SCOT) can be used to analyze the interplay between technological development and the social impacts of technology (Frisbie & Kasarda, 1998; Graham & Marvin, 2002). However, both of these frameworks are one-dimensional and have major shortcomings. A third framework called social shaping of technology (SST) combines determinism and SCOT by leveraging their strengths and weaknesses against each other. Central to SST is the analysis of technological direction, form, and outcomes as a cycle that occurs continuously throughout the process of innovation (Williams & Edge, 1996).

The framework known as social shaping of technology (SST) seeks to leverage SCOT and technological determinism against each other to create a singular sociotechnical theory that explains patterns of development. Traditional determinism offers up an explanation for how technology can impact social flows, but is based on the assumption that there is a singular form of the technology that is considered "best" from all standpoints (Wyatt, 2008). Determinism also does not acknowledge that technology is often shaped by the form that wins the race to early adoption. Social constructionism can cover some of determinism's issues with the definition of "best," but has the issue of structural exclusion: participation may be so restricted that some groups appear to not have an impact on the technological process. It also runs into the same issue as determinism of considering the social as separate from the technological (Mackenzie & Wajcman, 1999).

Central to the framework is the idea of opening the "black box" of technology to examine the social and economic factors contributing to the form of technology and the process of its development. SST also moves away from the one-dimensional logic present in both technological determinism and SCOT. Technological innovation occurs via a complex set of choices (both conscious and unconscious) that occur throughout design and implementation. Rather than a linear path to success, SST lays out what Williams and Edge (1996) call the "garden of forking paths" toward a myriad of potential forms (p. 866).

Examining any artifact through the lens of social shaping of technology raises questions about technological negotiability and choice irreversibility. Negotiability refers to the ability of diverse groups define and create a "successful" form of the technology. Irreversibility refers to the extent to which early forms of a technology become entrenched and immutable in later generations (Williams & Edge, 1996). SST entertains the idea of "closure" present in traditional social constructivism (Pinch & Bijker, 1984), but leaves the door open to future manipulation by social choices. As an analytical framework SST is concerned with three major elements of innovation: *direction* (and rate) of development, *form* of artifacts or processes, and *outcomes* for relevant social groups. Rather than focusing strictly on the social impacts of technology, it seeks to explain the why the technology took the shape it did and how the outcomes arose out of that (Williams & Edge, 1996).

It is in the direction, form, and outcomes, Hommels (2005) argues, that urban infrastructure has been historically inflexible. Urban innovation is a time-consuming and meticulous process than involves balancing a large number of social, economic, and technical needs. Planners, engineers, and architects often become fixed in particular ways of thinking based on a history of dominant worldviews. Approaching change can seem formidable as changing any one element also requires adapting linked systems to the new form. Over time, archetypes of design become embedded and continue to produce outcomes even after their logic has fallen out of use (ibid.).

Research Question and Methods

My research into the relationship between the social shaping of technology and the design of urban transportation infrastructure will be guided by this question: How have social pressure and technological growth combined to shape urban transportation infrastructure in the United States? In particular, I am interested in looking at how direction, form, and outcomes have created a feedback loop within the development process. Answering this question will take an extensive review of literature concerning trends or urban growth and planning. This review will be multifaceted, approaching the question from a variety of different perspectives and disciplines. The comparison of handbooks and manuals published by bodies like the Federal Highway Administration, such as the Complete Streets Design Guide (FHWA, 2022) and city planning offices will reveal how those groups have altered their priorities over time. These documents are crucial to dictating the direction of change as well as normalizing forms particular cases. Rate of change can be seen by comparing the differences between published editions of standard manuals. Prior studies completed by researchers on particular design cases may show how form can be implemented in more exploratory cases and can provide empirical evaluations of social outcomes. Social media accounts and campaign websites for various causes link directly to the perceived outcomes of technology by particular social groups and force technological direction from the social end of the spectrum. To link back to my technical project, I will also be conducting interviews with the University Architect offices of several colleges across Virginia. Due to their work, they are in a unique position to witness large-scale shifts in trends and are familiar with each element of the direction-form-outcomes cycle. Some preliminary ideas for interview questions are found in appendix A.

Conclusion

Our final deliverable to our industry mentor at VHB will be a set of completed design documents detailing our plans for the site layout, stormwater management, utility coordination, site access, erosion and sediment control, and construction administration. While we understand our design will not actually be constructed, we hope that we can provide some ideas from a perspective the professionals may not have considered. The STS portion of my project will explore the social and technological forcings behind the transportation design decisions that get made in projects like ours and how they translate to broader patterns of development. Going into the design process with an understanding of how and why social outcomes occur will allow engineers make more informed decisions. In the long run, understanding innovation through social shaping of technology may also help break down some of the barriers that slow the development of urban transportation.

References

Anderson, T. (2016). At a Crossroads. *UVA Magazine, Winter 2016*. Retrieved from https://uvamagazine.org/articles/at_a_crossroads.

Boeing, G. (2021). Off the grid… and back again? The recent evolution of American street network planning and design. *Journal of the American Planning Association*, *87*(1), 123-137.

Choi, J., Kim, S., Min, D., Lee, D., & Kim, S. (2016). Human-centered designs, characteristics of urban streets, and pedestrian perceptions. *Journal of Advanced Transportation*, *50*(1), 120-137.

Dodson, T. (2015). Board of Visitors hears new details about Emmet streetscape, Ivy Corridor. Retrieved from https://www.cvilletomorrow.org/bov-hears-new-details-about-ivy-corridor/.

DumontJanks, Biohabitats, VHB, & Landwise. (2016). Ivy Corridor Strategic Planning Study. Retrieved from https://officearchitect.virginia.edu/sites/officearchitect/files/2020-12/IvyStrategicStudy%20%281%29.pdf.

Federal Highway Administration. (2022). Moving to a Complete Streets Design Model: A Report to Congress on Opportunities and Challenges. Retrieved from https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-03/Complete%20Streets%20Report%20to%20Congress.pdf.

Forsyth, A. & Southworth, M. (2008). Cities Afoot – Pedestrians, Walkability and Urban Design. *Journal of Urban Design.* 13(1), 1-3. https://doi.org/10.1080/13574800701816896.

Frisbie, W. P., and Kasarda, J. D. (1988). Spatial processes. In Smelser, N.J (Eds.), *Handbook of Sociology* (629-66). London: Sage.

Global Designing Cities Initiative & National Association of City Transportation Officials. (2016). *Global street design guide*. Island Press.

Graham, S., & Marvin, S. (2002). *Splintering urbanism: networked infrastructures, technological mobilities and the urban condition*. London, UK: Routledge.

Hammerschmidt, S., Schoder, D., MacCleery, R., & McConville, M. (2020). Pavement to Parks: Transforming Spaces for Cars into Places for People [PDF file]. *Urban Land Institute.* Retrieved from https://knowledge.uli.org/-/media/files/research-reports/2020/pavement_to_parks_final.pdf?rev=fa261a5651424b22b89b465b0c9cf098.

Hommels, A. (2005). Studying Obduracy in the City: Toward a Productive Fusion between Technology Studies and Urban Studies. *Science, Technology, & Human Values*, *30*(3), 323–351. http://www.jstor.org/stable/25046609

Isaacs, R. (2000). The urban picturesque: an aesthetic experience of urban pedestrian places. *Journal of Urban Design*, *5*(2), 145-180.

Kelly, J. (2022). What's Happening at the Corner of Emmet Street and Ivy Road? Retrieved from https://news.virginia.edu/content/whats-happening-corner-emmet-street-and-ivy-road.

MacKenzie, D., and Wajcman, J. (1999). Introductory essay: The social shaping of technology. In D. MacKenzie and Wajcman, J. (Eds.), *The social shaping of technology* (3-27). Buckingham, UK: Open University Press.

Perkins+Will. (2016). The University of Virginia Brandon Avenue Master Plan [PDF file]. Retrieved from https://officearchitect.virginia.edu/sites/officearchitect/files/2020-12/BrandonAveMasterPlan.pdf.

Pinch, T. J., & Bijker, W. E. (1984). The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, *14*(3), 399–441.

Vanasse Hangen Brustlin, Inc. (2021). University of Virginia's Ivy Corridor Project Connects North and Central Grounds. Retrieved from https://www.vhb.com/news/ivy-corridor-underway-at-university-of-virginia/.

Williams, R., & Edge, D. (1996). The social shaping of technology. *Research policy*, *25*(6), 865-899.

Wyatt, S. (2008). Technological determinism is dead; long live technological determinism. *The handbook of science and technology studies*, *3*, 165-180.

Appendix A: Preliminary University Architect interview notes and questions

Prep: Look at Architect's bio page, recent or active projects on University website

Background

- How long have you been in this role?
- How many projects have you overseen in that time (including in progress)?

Recent Work

- What did your first project look like (in brief)?
  - Major focus areas, folks/groups involved, area
- What did (does) the most recent project look like?
- Are there any significant similarities between active or recent projects?

Design Process

- What does the design process look like for significant development/redevelopment projects?
- Are broader community needs incorporated into design goals? When or how?
- Is there a public input phase for all university projects, or just some subset?

Other

- Are there distinct "phases" of development you can identify over the university's history?
- Do any projects draw inspiration from similar universities or cities/towns around the country?
- What do you predict new projects will look like in 15 years?