What We Can Learn from the Ecological Zoo: Designing for Social Sustainability with Dynamic Community Input

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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

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Introduction

> For an animal, the question of survival is primarily physical; for man, primarily epistemological. Man's unique reward, however, is that while animals survive by adjusting themselves to their background, man survives by adjusting his background to himself.
>
> -Ayn Rand, *For the New Intellectual*

Initially, this quote seems relatively simple in its approach. We, as humans, run into danger like harsh elements or predators so we manipulate our immediate environment for protection. Where it starts to get less obvious, however, is when modern, more internal threats present themselves. For example, in the past fifteen years depression has doubled and suicide tripled on college campuses and the number of students seeking help for anxiety disorders has seen a noticeable uptick according to the Anxiety and Depression Association of America (Tartakovsky, 2018). This then begs the question: are college campuses an anomaly or have we started manipulating the environment in a way that hurts us more than it helps us? If we view a university as a sociotechnical system and these worsening feelings of anxiety and depression as symptoms of a disconnection to that university, we are made aware of system that is in no way sustainable.

The idea of sustainability has traditionally considered only environmental and economic impacts as they affect the surrounding community, however this causal relationship does not capture the full scope of what sustainability could be. If we truly want to design sustainable systems, societal impact must be explicitly considered in the design phase instead of thinking of cultural ramifications as reactionary parameters once construction is completed. Furthermore, disconnection among a college student body is a symptom of an unsustainable design and

therefore an opportunity for innovation in the field of social sustainability with respect to development of any site, not just college campuses. By evaluating these systems through an Actor-Network Theory lens, it becomes clear that there exists a severe disconnect in the holistic understanding of land development projects between pre and post-development actors who contribute to the overall sustainability of a site. Moreover, I claim that such a disconnect can only be remedied with malleable construction documentation that encourages end-user criticism at any point in development so that the social sustainability of a site is held as a priority.

Part I: Adolescent Isolation is Indicative of a Lack of Social Sustainability on College Campuses and Emblematic of a Systemic Problem

Adolescent Depression

College, specifically the first couple of years, is a time of such intense culture shock insofar as an individual is exposed to and overwhelmed by potentially thousands of similar aged individuals whose only connection to each other is the decision of where they went to school. Or, as Kathleen Cushman put it in Facing the *Culture Shock of College,* "[d]ifferences in income, social styles, and even speech patterns cause many students to feel like outsiders", should they fail to form a cohesive network of friends (p.2). To further complicate the issue, there is also the requisite sense of confusion and misplaced angst that comes along with being eighteen to twenty-two years old, not unlike James Dean's character Jim Stark in Rebel Without a Cause. To treat this movie and its creation as a microcosm of the sense of futility among adolescents, we see a similar, potentially universal, emotional disposition towards behavior in adolescents in the 50's as we do today. Or as Alyssa Costa provocatively put it in *'What It Takes to Be a Man': A Comparison of Masculinity and Sexuality in Rebel without a Cause and River's Edge* "[unlike] socio-cultural analysis, which only looks at the surface layer of film to show what is reflected of

the dominant culture, cultural studies delves deeper into the formulation of the films to uncover the ideological issues at work" (p.12) . All of this is to say that there are both inherent and situational stresses weighing on a new college student that create adverse headspaces for the student. The inherent stresses are static and have been present for quite some time, but the situational stresses are dynamic and can therefore be mitigated by reevaluating the college system as a whole.

The question, then, is what is the engineer's role in a problem about the mental health of adolescents? In working off of the definition of a professional as outlined by Lee Shulman in *Theory, Practice, and Education of Professionals*, an engineer is one who provides a "worthwhile service in the pursuit of important human and social ends" (p.9). So, just because a problem like disconnection from a university is difficult to understand does not mean that it should be overlooked as it is a pursuit that increases the wellbeing of the community. With colleges and universities incessantly retrofitting old and erecting new facilities, as outlined by Figure 1, engineers are at an inflection point where they can continue thinking about design and construction as a purely technical endeavor, or instead embrace a new avenue of design thinking that holistically evaluates the cultural utility of a project and potentially increases the overall connectivity of that site.

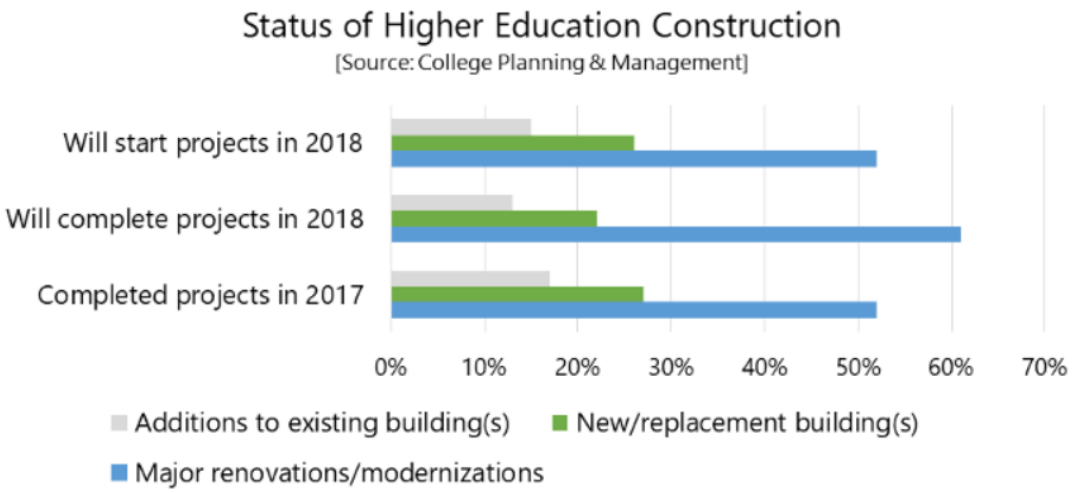

Figure 1. State of College Construction. College campuses are frequently undergoing significant construction, mostly during the summer months and between semesters so as to minimize impact to the students. This presents an opportunity for innovation in how the design and construction phases are handled to ensure student satisfaction once the project is finished (Barry, 2018, n.p.).

Engineers as Sustainability Architects

When design and construction firms take on a project, the number one priority is avoiding any discernable risk to the end user, in this case college students (Fisk and Rosenfeld, 1997). This is a logical and sufficient process, yet Judith Heerwagen sees a blind spot in ingenuity, particularly in the fact that "there are no standards on how to design to *promote* health and wellbeing [instead there are standards that detail how to comply with social health]" (p.1). To better understand the nuance in diction, Heerwagen sites the history of zoos as a parable. Originally, zoos were built merely to sustain animal life in exhibition cages so that humans could pay a fee and safely see animals that they otherwise would not be able (p.2). The experiment was a success in that the animals all survived and the humans left the zoo unharmed. However, this cage-oriented design failed in that the animals did flourish, did not reproduce, and showed aggression towards other animals. Moreover, the animals began to atrophy physically and

mentally due to lack of exercise and stimulation (p.2). To combat this, zoologists and biologists explored a new strategy, that of the ecological zoo. By simulating the native environment of the animals, the once caged creatures were able to move around and interact with all of the biotic and abiotic components of the zoo that mimicked their biome (p.2), mitigating most of the problems created by the exhibitionist cage model.

Research by behavioral scientist Boyden (2000) identifies six factors that support a good building habitat, the most relevant to land development being a sense of community, belonging, and connection to nature. The latter was first identified by Ulrich (1984) in which hospital patients situated in rooms with views of trees and vegetation had more positive recovery than a matched group whose view was a brick wall. Further research by Ulrich (1993) concluded that subjects recovered from stress more quickly and were in more positive moods when shown urban scenes with nature when compared to subjects whose views contained no natural elements. While the quantification of social connectedness is difficult, the economic benefit of a socially cohesive development is becoming clearer with developing research. Heerwagen cites the example of hedonic value, a line-item component in the sum total value of a home, and finds that people are willing to pay for "good" views such as water or proximity to trees and hiking trails.

In a century that will be defined by the debate about and effects of climate change, most or all new engineering developments are designed so as to be sustainable. However, that word has become so engrained in the modern lexicon that its meaning may be lost by repetition. Going back to its inception, according to Simon Dresner in *The Principles of Sustainability*, "[t]he concept of sustainability in something like its first modern form was first used… in 1974… by Western environmentalists in response to developing world objections…", or, in its nascent stages its fundamentals were inexorable from environmental concerns (p.14). But as the world

and the market evolved so the did the definition of sustainability to the point where in 1987, the definition of sustainability was understood as "meeting the needs of the present without compromising the ability of future generations to meet their needs" with overt emphasis on specifically environmental and economic parameters (Turner, 1993).

Yet, as was shown by Heerwagen's ecological zoo and Boyden's good building habitat, there is another component along with economic and environmental sustainability that must be included in the needs of a generation: social equilibrium. The overall functionality of a project is a directly related to the mental health and well-being of the residents therein and thus the increased prevalence of cases of anxiety and depression among college-aged students may be symptomatic of the cage-oriented zoo. The remainder of this paper will evaluate government owned land development projects (which for all intents and purposes are identical to college campus construction projects, just on a larger scale) to see where principles of the ecological zoo can help engineers design socially sustainable atmospheres.

Part II: The Current Development Model Enables Culturally Disjoint Design: Better Understanding Holistic Sustainability in Practice

Starting from the Beginning: Sustainability in Construction Documentation

For the most common case of construction documents, Design-Bid-Build (DBB), the owner has an idea for a project in mind and asks numerous design and construction firms to submit bid packages outlining how they would complete the project and how much it would cost. The owner then chooses whichever firm they have deemed to have presented the best package (based on numerous criteria such as: experience in the field, size of company, past work, previous collaboration with the owner, schedule, cost, etc.). Ostensibly, these components break

down into two discrete categories: value and performance (Molenaar and Johnson, 2003). For most owners, but specifically for public projects in which payment for the project more or less comes from taxes, it is often the cost that is the deciding factor for which firm the owner will choose (Ballesteros-Perez et al., 2017). The societal impact of a project falls into the often-overlooked category of performance, which is already a multi-faceted parameter that the owner must consider and prioritize elements within. The category of performance may include as many things as: lifetime, ease of decommission, energy efficiency, environmental impact, economic benefit, historical considerations, and much more before social cohesion.

To further muddle the transparency of development, the DBB process is, by nature, strictly linear. First the owner chooses a design and construction firm, then a contract containing all aspects of the project is drafted and agreed upon, then any subcontractors are hired to actually carry out the field work to complete the project. That is to say that once the parameters and execution of the design are outlined, they are effectively set in stone, as any deviations from the contract are going to come out of the contractor's pocket unless it has been approved by the owner. This structure is in place so that no one entity can manipulate the project for individual gain, but what it also does is limit the flexibility among all parties should the owner change its definition of the scope, or goal, of the project later down the line. Although the government entities should theoretically represent the best interests of the residents, there are too many degrees of separation from the community members who have expressed need for some project and the parties that make that project come to fruition in a sustainable way.

The takeaway from the ecological zoo is helpful in highlighting a caveat that had plagued many a project: a design may be sound on paper and in the early stages of operation, but if special attention is not paid to the social parameters of sustainability from the outset, the cultural

fragility of the design will negate the technological proficiency. With this newfound understanding of how sustainable design includes the social cohesion among the end users, we can employ an Actor-Network Theory (ANT) approach to better understand the relationship between the community, designers and owners of future projects.

Understanding the Disconnect between End-users and Designers

The cornerstone of Actor-Network Theory relies on the process of breaking down a sociotechnical system into discrete components to understand how actors interact with each other and contribute to the functionality of the system. In order to isolate the sustainability of a system as the quasi-dependent variable of this research, actors will be broken down into categories of living and nonliving and whether they contribute to the three-pronged sustainability pre-development (in the design phase) or post-development (inhabitants of the completed project). In doing so, a crucial, but in no way comprehensive, collection of actors emerges. The living actors being: designers, architects, owners, construction firms, government agencies responsible for permitting, owners of shops, and patrons of facilities. The nonliving actors being: the environment and the actual infrastructure to be developed. The predevelopment sustainability actors are quite obvious (all mentioned actors barring shop owners and patrons which are post-development sustainability actors).

Once the actors have been broken down into like categories, the relationship among actors can be examined. In doing so, two main types of relationships emerge. The first being the tacit relationship that exists between the pre-development (designers) and the post-development (end-users) sustainability actors. As will be covered further in the next section, this relationship proves almost entirely one sided as it is the pre-development actors who frame the experience of the post-development actors implicitly by designing the site in a particular way, whether it

restricts or allows for social sustainability. Another important characteristic of this relationship is the fact that there is not a direct line of communication between these actors, instead they often communicate during the design phase by way of an intermediary, specifically the owner. The next type of relationship is the direct association among the living post-development sustainability actors. It is this relationship that serves as the metric for how socially sustainable a site is. Although this relationship is direct, it is entirely colored by the decisions of the pre-development actors in the design phase.

Now that ANT has been used to breakdown a sociotechnical problem into a usable set of individual components, we can use the template that identifies different Attitudes Towards Technology (ATT), described by Christian Kerschner and Melf-Hinrich Ehlers (2016), to frame how certain actors feel about technology. Figure 2 highlights the discrete categories of ATT. The three most relevant attitudes for construction and development are enthusiasm, determinism, and skepticism. Because land development, specifically for commercial use, is a process that inherently affects day-to-day lives of community members, these attitudes must be carefully understood (both the attitude itself and why the attitude is felt by a particular actor) and analyzed to enhance connectivity. Once the attitudes of the post-development sustainability actors are understood, the pre-development sustainability actors should be able to better understand the needs of the public and in turn design more socially sustainable systems.

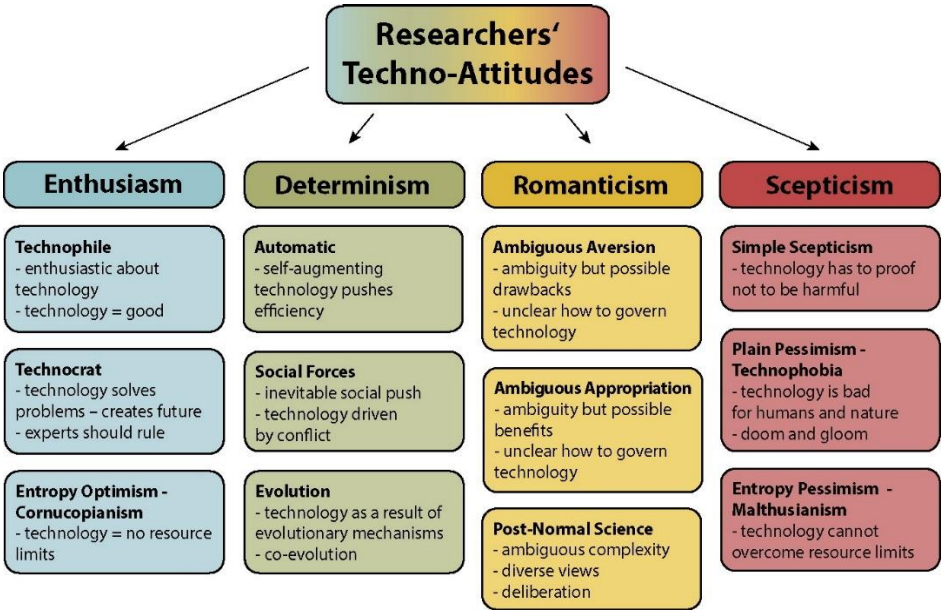

Figure 2. Attitudes Towards Technology. The twelve different attitudes, identified Kerschner and Ehlers, that may be adopted by researchers. Of course, these feelings are on a spectrum and do not inherently fit neatly into these discrete categories, but for the sake of visualization and understanding, this chart is helpful for expressing the varying degrees of appreciation for and apprehension towards technology in the abstract (Kerschner & Ehlers, 2016, p.143).

Part III: Linear Construction Documentation is Ineffective in Replicating the Nonlinear Attitudes of Community Members

After applying an ANT approach to the current land development model, a severe disconnect between pre- and post-development sustainability actors is made more than apparent. The most jarring of which being the relationship between a government body, a private design firm and the inhabitants of the area where the development project will occur. Specifically, government and private design actors reach some conclusion behind closed doors that outlines the parameters of the project via a legally binding contract. Yet the government's relationship to its citizens is much more fluid. So, in this oblong triangle of influence, there is the government contractually obligated to be delivered a product by a private firm, and the community that will

be using the product has no binding document outlining their wants for the project. As mentioned before, the government is supposed to act in the best interest of the people, so for all government construction projects, a town hall is advertised and conducted. Now, this proves to be entirely insufficient based on the insight gleaned from the ATT framework, which will be discussed shortly. As a clarification, everything heretofore has been assuming publicly owned and financed project- the "best case scenario" for the public as town halls are mandatory and funds are generally transparent (Azhar, Kang, & Ahmad, 2013).

The Changing Perspective of Community Members

This disconnect between the attitudes of temporal actors yields a preliminary result that reframes how the relationships between actors are classified by ANT. As was mentioned previously, there exists a direct relationship between the post-development actors as they socialize on the site during the site's implementation phase. After further evaluation by the ATT framework, it becomes clear that this relationship is tacitly influenced by the pre-development actors. It is the pre-development actors who set the stage for the interactions that the post-development actors will have within the project. The post-development actors are having a conversation in a new language written by the pre-development actors, therefore the amount of information exchanged (the sustainability of the site) is a function of how well the pre-development actors understood the post-development actors' old language (their wants for the project).

Now that the disconnect in stakeholders is identified, the ATT framework can be used to understand why this has happened, and potentially, where to start if socially sustainable systems are to be developed. Through ATT, the engineers and design architects can be classified as enthusiastic technocrats/technophiles, or actors who believe that what they are doing is solving

the world's problems thus providing utility to the community. Private construction firms, even more motivated by the bottom line and practicality, can be classified as evolutionary determinists or hold the opinion that technology is a tool that evolves to carry out design ideas. The key finding from this research, however, is the attitude assumed by community members and, more specifically, how those attitudes change as a land development project proceeds with time. Initially, community members are techno-determinists in that they feel that there is some push, social or not, that is driving innovation (in this case, the innovation is land development). This is corroborated by relatively low attendance at town halls and by the fact that those who do attend town halls are very agreeable to big picture ideas without thinking about how that final goal will be reached. Yet this attitude shifts drastically as soon as land is cleared and construction equipment is put on the site. Community members in the area shift from techno-determinists to tecno-skeptics or the "guilty until proven innocent" approach as their traffic pattern is disrupted, there is more dirt on roads/cars, noise pollution from construction, and the realities of development start to set in. When faced with these realities the community becomes woefully dissatisfied with what is happening in their backyard and begin to look critically at the development process.

This is the exact point where people start to exercise their civic duty and contact their representatives to voice their discomfort, however the contract documentation has been signed months or years before the groundbreaking (Burdge & Robertson, 1990). Figure 3 shows how much the overall project can be influenced as a function of which phase of construction/development it is currently in. It should be noted that once the physical manifestation of design is underway, when community members start changing their scope, there is only about 30% of leeway to adjust the final construction.

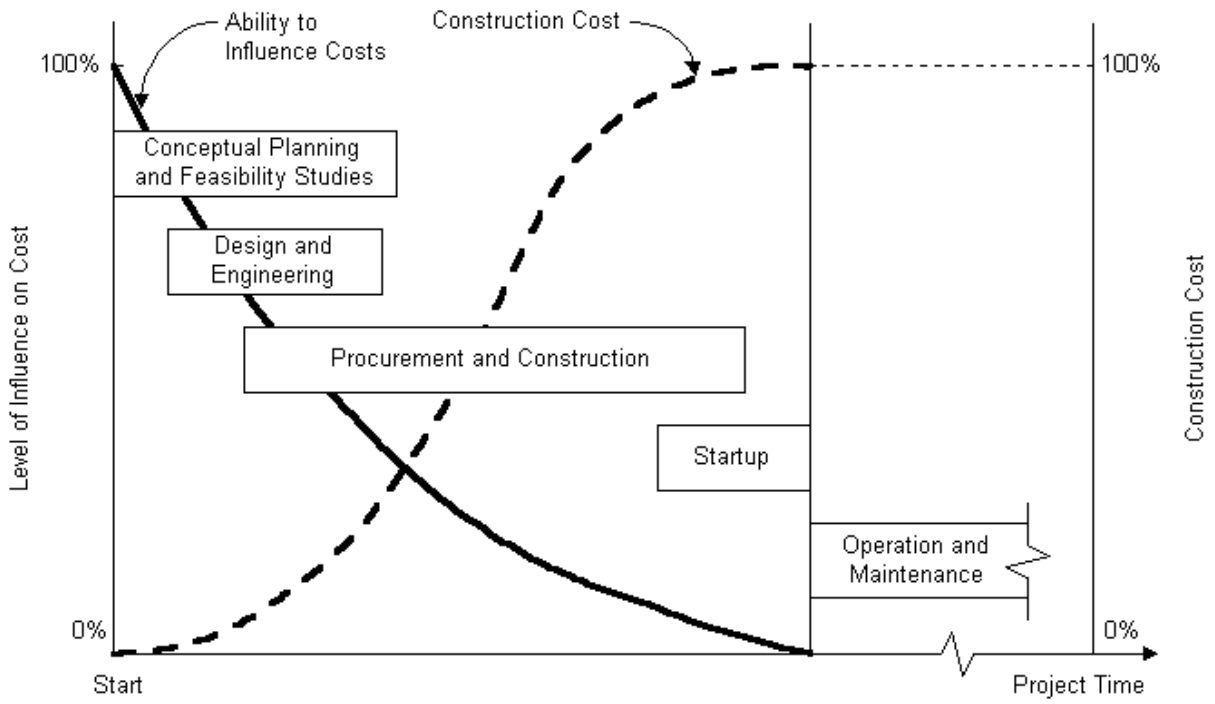

Figure 3. Design-Bid-Build Cost and Influence as a Function of Time. For public DBB contracting methods, the curve marked "Ability to Influence Cost" can be assumed to also represent the ability to change what the final design looks like. Again, because DBB is linear and cost is determined at the outset in the contract, the influence of cost is 1:1 with the influence of design (Hendrickson & Tung, 1998, n.p.).

The government actors are thus presented with a seemingly impossible decision: do they renegotiate the terms of the contract (doing so will drastically delay the project and increase the cost which in turn increases taxes), or do they continue with the project designing something that the public doesn't want as much as it thought it did? Instead of answering this question, I propose a different approach to construction documentation that renders it mute- construction documentation that is dynamic so as to reflect the robust and fluid nature of community goals. As we learned from the ATT framework, when a project is in development and people at the town hall hear about how much better their lives are going to be because of it, people are agreeable because at this point it is only an idea on paper and in theory. Once the reality sets in, however, and people see what's actually being built and how it is getting there, they eschew the

needs of the future for the comfort of the present. So, each actor wants the same thing, just the post-development sustainability actors change how their wants should be satisfied as their environment changes with time. The problem with post-sustainability actors is not apathy, but rather a phase shift in activism that is lagging behind linear construction documentation. Government agencies must allow their contracts with these design firms to be as fluid as is the relationship between citizens and its government so that a change in scope, as defined by the post-development sustainability actors, can be met with a change in execution controlled by the pre-development sustainability actors.

Conclusion

Just an Ayn Rand said, it is within human nature to manipulate the environment to satisfy basic human need. As human needs evolve from those basics (shelter, protection) to the modern (comfort, profitability), so does the means with which we manipulate our environment. Humans have become advanced enough to develop systems that abate adverse environmental impacts of a project and create micro-economies that yield positive feedback loops to increase the profitability of a site. Yet, these systems are only components nested within the larger sociotechnical system that includes people and their daily interactions. The disproportionate emphasis placed on the technical components of design yields a development with a fractured sense of cultural connection, as evidenced by the worsening feelings of isolation and depression on college campuses.

It has never been a stretch to refer to college students as animals, but by doing so through the lens of an ecological zoo we become aware of a systemic blind spot that is preventing communities from reaching their full potential. Through the studies of Boyden, it is clear that there are externalities, such as proximity to nature or access to naturally lit rooms, that make

people more productive and comfortable in their living or working environments. Conversely, by designing technologically subsistent systems engineers actively decrease the social cohesion of a project and therefore worsen the demeanor of the inhabitants. If we truly want a sustainable design in the holistic sense of the word, we must look deeper into the cultural need of a project and allow the community voice to be acknowledged continuously during the actual development of the site.

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