DESIGN AND CONSTRUCTION OF A SUSPENDED FOOTBRIDGE FOR THE COMMUNNITY OF COILOLO, BOLIVIA

THE EFFECTS OF COMMUNITY INVOLVEMENT ON THE SUSTAINABILITY AND SUCCESS OF INFRASTRUCTURE DEVELOPMENT PROJECTS

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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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General Research Problem: Sustainable and Successful Infrastructure Development Projects

What defines a Sustainable and Successful Infrastructure Development Project and is there an observable general model that can be applied to ensure the sustainability and success of these projects?

Many low-income communities have a significant need for essential infrastructure development. These underserved communities struggle with the availability of clean water, the ability to be connected to essential resources, and housing. The World Health Organization estimates that "1 in 3 people globally do not have access to safe drinking water," (World Health Organization, 2019). According to the World Bank, "One billion people still live more than 2km away from an all-weather road, where lack of access is inextricably linked to poverty," ("Transport Overview", 2022). Underserved communities' needs fluctuate and appropriate solutions can have further varied by cultural norms, geographic boundaries, and a multitude of other variables. Therefore, outside organizations have to tread carefully when providing infrastructure to develop underserved communities to ensure that their project is truly beneficial. Correctly addressing a community's needs defines the success of the project.

The Engineers in Action Bridge Program is a great example of an outside organization providing essential infrastructure to underserved communities in the form of suspended footbridges. They partner closely with the community they wish to serve to ensure the design and construction of the footbridge they provide is heavily influenced by needs that are stated by the community members. Engineers in Action also heavily involves the community in the construction of the footbridges they provide to teach the community how they can maintain and repair the footbridge. Sustainable infrastructure development must focus on establishing avenues to guarantee their projects will have a long and efficient service life.

Working with Engineers in Action my capstone group will design and plan the construction of a footbridge for the rural community of Coilolo, Bolivia. This footbridge will provide the Coilolo community with access to essential resources. There are many examples of similar infrastructure development projects that place a heavy emphasis on ensuring community involvement. There are two case studies done in Ohafia, Nigeria, and Bandung, Indonesia, that clearly demonstrate the need for community involvement in infrastructure development projects. Examining the processes of these two case studies will produce an observable model that can be applied to ensure the sustainability and success of infrastructure development projects. This paper will attempt to show the key aspects of a sustainable and successful infrastructure development project to inform the direction of future development projects.

DESIGN AND CONSTRUCTION OF A SUSPENDED FOOTBRIDGE FOR THE COMMUNNITY OF COILOLO, BOLIVIA

How can students at UVA be involved in the design and construction of a suspended footbridge to benefit the community of Coilolo, Bolivia?

Working with Engineers in Action, our group will design and assist in the construction of a suspended footbridge for the community of Coilolo in Bolivia. This footbridge will provide the community of Coilolo with access to essential activities and places, which were previously cut off by the Rio Coilolo during the rainy season. The river can overrun its banks for up to six months in this region of Bolivia, cutting a line in between the community of Coilolo and their direct access to a large portion of their fields and markets to sell their crops. The river also cuts off access to the nearest school for the community of Coilolo.

The Engineers in Action Bridge Program, an essential branch of the overall non-profit organization Engineers in Action, builds suspended footbridges for underserved communities around the world. Engineers in Action (EIA) selects communities that are both underserved by their government and in need of access to essential resources. EIA then works with students across the U.S. to educate them in real world bridge design by allowing the opportunity to propose potential designs a for suspended bridge. The EIA Bridge Program mission statement is

> Isolation caused by impassable rivers is a root source of poverty all over the world. Fueled by the passion of university students and the wisdom of our local partners, we build footbridges with isolated communities to ensure they have year-round safe access to essential resources such as education, healthcare, and markets. (Engineers in Action Bridge Program)

In order to complete this project EIA relies on two main groups, the community of Coilolo, and the students involved in the design. The community of Coilolo is responsible for providing EIA with adequate site information and a statement of community needs that can be mitigated by a footbridge. Also, the community of Coilolo will provide the main work force for the construction of the footbridge. The students, in this case, our capstone group, will be responsible for proposing a design for the suspended footbridge and preparing a construction plan for the bridge. EIA has provided our group with design modules that instruct on how to complete a design plan set and a construction plan for a suspended bridge. The main components of suspended bridge design are the design of the abutments, cables, and decking. The information contained in these modules is summarized in a design guide our group references (“Bridge Program Design”, 2022). Our group will be responsible for developing the needed skills to complete the standard design components so that we are capable of altering the standard design to fit our site. Our group has already had to implement non-standard designs for our site’s abutments by increasing our foundation heights. The alumni and faculty technical advisors will be an essential resource to ensure our design meets industry requirements and standards.

THE EFFECTS OF COMMUNITY INVOLVEMENT ON THE SUSTAINABILITY AND SUCCESS OF INFRASTRUCTURE DEVELOPMENT PROJECTS

How does community involvement and buy in help ensure that infrastructure development projects conducted by outside organizations are sustainable and beneficial for the community they are trying to serve?

There are many organizations that work in underserved communities to provide essential infrastructure such as roads, bridges, housing, water access, etc. These organizations however do not often consider much more than the constructability and economy of the project without considering the durability, serviceability, and maintainability of the project. Not focusing on the durability, serviceability, and maintainability of the project can lead to unsustainable infrastructure being put in place that does not provide lasting benefits for the community. One practice that is used to help community development organizations ensure the sustainability and success of their projects is involving community members throughout the life of the project. Involving the community throughout the project has been shown to mitigate assumption of needs and lead to projects that are both sustainable and successful. I will examine several infrastructure development projects that focus heavily on community involvement to observe best practices to ensure community engagement and examine the effects this involvement had on the projects' success.

The main two infrastructure development project case studies I will examine were conducted in Ohafia, Nigeria, and Bandung, Indonesia. While these case studies both focus on infrastructure development in low-income communities, there are many differences in the two communities that these studies focus on. There are overarching sociotechnical aspects that both communities share. The main groups and organizations associated with these studies consist of the community development organization, the underserved community, the government who underserved the community, and the supporters of the community development organization. Each community has a variety of different norms and values that define the specific needs of the community. The community in Bandung, Indonesia, is extremely urban while the community in Ohafia, Nigeria, is more rural. This change in setting is a norm that greatly influences the infrastructure needed and the optimum strategy to engage the community group. The two case studies also highlight a wide range of funding and implementation processes used by the two different community development organizations.

The case study on Ohafia, Nigeria, focuses on a community-based approach to infrastructure development. The article states that "The strategy of private sector and community participation in development is increasingly gaining recognition as an important tool for mobilizing resources and organizing people to take collective action in providing for their welfare in Nigeria," (Ibem, 2009). This study states that the reason that makes community involvement so essential is to determine the infrastructure needed. Also, this approach allows the community to contribute to the solution, allowing for future infrastructure provision to originate within the community. When the government or outside agencies determine what a community needs, this study states that this development is not sustainable for the community and can often fail to diagnose the community's true needs. One of the practices this community development

group performed to ensure community buy in was to conduct questionnaires. Their questionnaires focused on individual community members' opinion on the development project and the personal impact they were able to make on the project. (Ibem, 2009)

The study done in Bandung, Indonesia, had the main purpose of proposing a model for basic infrastructure provision for low-income communities. "This study recommends community-based model to be implemented in delivering infrastructure services for low-income groups," (Maryati, Humaira, 2015). This study measures the effect of the community involvement through descriptive and comparative analysis of the projects. This study also presents in depth analysis of the need for outside involvement in infrastructure provision. The study states that the low-income groups in Bangladesh only receive 20% of the infrastructure subsides from their government. With such little support from their government the low-income communities in Bandung lack basic infrastructure such as access to clean water and adequate housing. This study, while focusing on housing only and using a different methodology, still indicates that community involvement plays a large part in the process of providing infrastructure. (Maryati, Humaira, 2015)

Both of the cases have a wide range of strategies to ensure community involvement. Using evidence from these two cases and other sources explaining infrastructure development in the communities these case studies focus on will help define the level of success for each of these strategies. Examining the immediate impacts listed by the studies at the time of their occurrence as well as the future impacts, that can now be investigated, will help define the level of sustainability and benefit of the infrastructure development project. The level of sustainability and benefit of these cases will determine the role that community involvement plays in sustainable and successful infrastructure provision in underserved communities.

Conclusion

Through examining the case studies presented above a direct tie will be made from community involvement to the sustainability and success of an infrastructure development project. These case studies carefully document their key strategies and processes to ensure buy in from the community they are serving. They also include in their methodology a clear way to define the results of this community involvement. The evidence from these case studies will present how community involvement is vital to sustainable and successful infrastructure development. The experiences gained throughout the year long process of designing and creating a construction plan for a real-world infrastructure development project will help define the challenges that arise in this system. The communication between my capstone team, EIA, and the community of Coilolo will better inform the steps that are necessary to ensure community involvement in our project. Overall, the experience from these two areas of research will result in a general model that can be applied to future infrastructure development projects.

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