BRIDGING THE GAP: USING PEDESTRIAN BRIDGES TO CREATE RELIABLE ACCESS TO ESSENTIAL RESOURCES

THE PRESENCE AND IMPACT OF TECHNOLOGICAL LEAPFROGGING IN INFRASTRUCTURE IN UNDERSERVED COMMUNITIES

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SOCIOTECHNICAL SYNTHESIS

Over one billion rural residents globally do not have all-weather access to essential resources, like markets, schools, and healthcare; this isolation of rural people is a significant impediment to economic and societal development and is a major factor in the persistence of rural poverty globally. Technological solutions to this problem have been developed by engineers with varying degrees of success--like the pedestrian bridge designed in the technical project--mainly due to the failings of technological leapfrogging, the development strategy used in these projects. Technological leapfrogging, which is the subject of the STS research paper, can cause failure in projects when its connection to contextual factors surrounding a technology is ignored. For leapfrogging projects that work towards ending rural poverty, whether it is a pedestrian bridge or a hydroelectric power plant, success is imperative. Understanding the contextual factors that cause leapfrogged projects to fail is essential in assuring project success and working towards ending rural poverty and isolation.

The technical project calls for the complete design of a suspended pedestrian bridge for a rural village in Bolivia. The project was undertaken by a team of eight engineering students with the client, Engineers in Action. The village for which this bridge will service faces weather-based isolation for about six months of the year, when the neighboring river floods during the rainy season. This flooding makes the river impassable, reducing access to essential resources like the school and agricultural markets. With this bridge, the residents of the village will have reliable, all-weather access to these resources, creating economic and educational opportunities and connecting them to the major local population center of Zudanez. The team created the bridge design and construction plans over the course of 8 months. Using the Engineers in Action education courses on bridge design and construction, team members were able to learn how to safely design a bridge that would be built without standardized materials and equipment, as well as develop construction, safety, and quality control plans to construct the bridge on site.

The final bridge design consisted of a pedestrian bridge with a span of over 57 meters and two custom abutments. The bridge site, as a flatter floodplain, posed some challenges to achieving safety requirements and as such, required custom abutment designs on each side of the bridge. These custom designs allowed for the design to achieve both the safety requirements and serviceability needs of the site. In the construction plan, details for site excavation are discussed, as well as guidance for the project schedule, materials and tools, safety, and quality control. This will accompany the bridge design documents on site as it is being built this summer.

The STS research centers around technological leapfrogging, the strategy that Engineers in Action employs with their pedestrian bridges. Leapfrogging is the “skipping” of stages in technological development with the aim of more rapidly reaching a higher level of advancement and can be a powerful developmental strategy. However, the lack of consistent and continued success of leapfrogged projects is a weakness of this strategy. How can one confidently implement this developmental tool to ensure the benefits of the strategy, without the detrimental effects? The research and analysis of case studies of leapfrogging failures using the System in Context framework in this paper will work to define a set of conditions for which a project is most susceptible to the negative impacts of technological leapfrogging to inform recommendations for implementation in the technical project and future projects.

The paper explores the projects of Yachay City and Coco Coda Sinclair in Ecuador and the N250 project in Indonesia and analyzes them through the lens of the System in Context framework. From these case studies, the conditions of technological determinism, as well as techno-nationalism, were identified as the main contributors to the failure of leapfrogged technologies. By fully understanding these factors that prevent designers from considering the technological and societal context surrounding a technology, they can be reduced or eliminated to promote development through leapfrogging while minimizing its detrimental effects.

Identifying these specific factors that contribute to the negative effects of leapfrogging is only a first step towards determining how to implement this development strategy and be confident of success. To create meaningful and impactful solutions to problems, engineers must consider and incorporate the context and environment into both the design and implementation process.

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