Thesis Project Portfolio

Life Cycle Assessment of Stainless Steel Surgical Tools (Reusable vs. Single-use) in the UVA Hospital
(Technical Report)

Unmasking Complicity: A Kantian Examination of Child Labor in the Surgical Instrument Manufacturing Industry of Sialkot, Pakistan
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring, 2024
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Sociotechnical Synthesis

My technical work and STS research paper examine different elements of the single-use steel surgical tool industry. While my technical project examines the environmental impacts of using single-use tools instead of reusable tools at the University of Virginia Hospital, my STS research examines the use of child labor to manufacture single-use instruments in the town of Sialkot, Pakistan through the framework of duty ethics. The two projects combine to paint a comprehensive picture of the many negative impacts of single-use surgical tools.

My technical research project is a life cycle assessment (LCA) that evaluates the environmental impacts of single-use versus reusable stainless steel surgical instruments within the University of Virginia Health System. The research uses an analysis of four environmental factors, focusing on cost, global warming potential (GWP), electricity usage, and water usage. The investigation presents functional units, data acquisition encompassing weights, costs, usage metrics, and impact assessment across each life cycle stage, including production, utilization, and end-of-life. The breakeven analysis demonstrates substantial cost savings and reduced GWP with increased adoption of reusable instruments while also showing challenges in water consumption for autoclave sterilization. Sensitivity analysis highlights the financial benefits of transitioning to a more reusable-focused hospital system. The findings underscore the potential for healthcare facilities to achieve significant economic savings while addressing environmental concerns by adopting reusable stainless steel surgical instruments.

My STS research paper explores the ethical implications of child labor in the steel surgical instrument manufacturing industry in Sialkot, Pakistan. It begins by highlighting the industry's reliance on cheap exploitative child labor and the complicity of distributors who profit from selling these instruments at exorbitant markups. Despite extensive documentation of the

issue, little has been done to address it, prompting the need for an ethical analysis. The paper uses the framework of Kantian ethics to argue that child labor in Sialkot violates both versions of Kant's categorical imperative by failing the universality principle, using children as a means to an end, and denying children their autonomy. Through detailed evidence and analysis, my paper proves that the use of child labor is morally unacceptable, and anyone involved in the supply chain is complicit in perpetuating this practice.

Working on these two projects together has been an incredibly valuable experience, as it has allowed me to view one issue from two entirely different perspectives. I first learned about the child labor occurring in Sialkot while conducting research on the supply chain of single-use instruments for my technical project in the fall. Researching the abhorred conditions under which these devices are made has significantly raised the stakes of the technical project by highlighting an entirely separate problem that goes almost completely unnoticed. My research has prompted me to reflect on the many different ways one industry can impact the world. When combined, the environmental and ethical cases presented in this thesis make a compelling and multifaceted argument for the transition away from single-use surgical instruments.