Thesis Project Portfolio

Martian Airborn Residue Remediation System:

Dust Mitigation on Mars via Electrostatic Precipitation

(Technical Report)

An Analysis on Common HVAC Systems and

How They Can Spread Harmful Dust Particles

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My capstone research is to address a technological shortcoming anticipated for the future trip to Mars, in particular how to prevent Martian dust from entering the astronauts' habitats. The technology that is being heavily researched and utilized in our design is the EP, electrostatic precipitator, which would charge the dust particles and attract them into an oppositely charged plate for collection. It is important to consider the human and social dimensions of this problem as it can be related to a common societal issue we face on Earth. Harmful inhalation of dust is not only a problem for this mission, but an overlooked issue that can take place in many homes with HVAC (Heating, Ventilation, and Air Conditioning) systems. These systems help regulate temperature and humidity by circulating cooled/heated air throughout a building. However, this also directly causes dust that comes in from the outside or is generated inside to be constantly spread in the air through circulation. To combat this, the dust filter was invented to trap non-air particles from passing through. However, these devices don't work forever and require replacement often, leaving the burden of maintenance on the common person.

Susan Star's theory of infrastructure can be used to analyze the problem solving approach. She outlines the many properties of infrastructure, one being fixed in modular increments. This restricts the feasibility of certain extreme solutions, such as EPs, due to the resources required to update technologies involved with HVAC installation. The most relevant aspect of a successful technology is that it is visible when broken. HVAC systems arguably do not align with this as airborne dust particles are hard to see and dust filters are not installed in plain sight. My research methods were primarily a qualitative look into the harms that can be caused from household dust and a quantitative analysis of the effectiveness of dust mitigation methods. I expect to find that there are alternative dust mitigation methods that have a higher

filtration rate than the household standard. However, these other methods would require a large-scale change in HVAC practice and standards while not solving the inherent issue that the consumer would not be aware of a decrease in filtration performance. Therefore, an easily accessible solution to the social issue would be to standardize the installation of dust sensors that alert the homeowner of dangerous increases in airborne dust particles. The implication of my technical and social research should be that existing dust mitigation systems are very effective in protecting lungs from damage as long as they are maintained accordingly.