Prospectus

A Device to Recharge Batteries from Mechanical Means
(Technical Topic)

Thirty Meter Telescope and Mauna Kea
(STS Topic)

By

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December 3, 2019

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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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Peer Review and Comments:

Comments by my peers have been taken into account while writing the final draft of my prospectus. Changes I have made to my prospectus have been highlighted in gray. I'd like to thank the following people for their time and their contributions to my prospectus.

Professor Gorman helped me to clarify the STS frameworks I will be using to analyze the Thirty Meter Telescope protests. I am taking his advice and will be using the concept of a Trading Zone to analyze the current situation rather than using Actor Network Theory. Per his comments, I will also make sure to keep in mind what the minority will lose when using the Utilitarianism framework to analyze the problem. Professor Gorman also suggested looking into other telescope construction projects around the world and if there were any protests on those sites. I have looked in to it, but I have decided to leave it out of my prospectus. However, I think analyzing other cases may still be helpful and I may include a discussion of it in my thesis.

My capstone professor, Michael Momot, has also contributed to my final prospectus. He has pointed out grammatical errors in my first draft that have now been fixed. I'd also like to acknowledge that the TMT has nothing to do with our technical topic.

While discussing the Thirty Meter Telescope with my astronomy professor, Shane Davis, he brought up an interesting point about how some astronomer's careers depend on being able to use the telescope for observation. I have added a section in my prospectus to discuss this.

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STS Prospectus Revised Draft

STS Introduction:

In July of 2019, construction of the Thirty Meter Telescope (TMT) was set to begin after years of legal challenges and delays. Instead, construction crews were met with hundreds of protesters who blocked the access road to the summit of Mauna Kea, a mountain in Hawaii, where the telescope is to be built. The goal of this paper is not to present an argument for or against the telescope. Instead, I will explore the benefits and consequences of the TMT and examine the interaction between science and culture. Problems can arise when the pursuit of science views itself as transcendent, noble, and above all else. Local people, who are the most affected by these science projects, often have different wants and needs, which creates conflict between the scientific community and the local people. I will use various STS frameworks to analyze if there is any way to bridge the gap in understanding between protestors and astronomers in the TMT case.

Background Information:

Captain James Cook first made contact with the people of Hawaii in 1778. Since then Hawaii was seen as strategically important for many European nations as well as the United States. This culminated with the overthrow of the Hawaiian monarchy in 1893 and subsequent annexation by the United States as a territory.[1]

[1] Hawaiian Monarch Overthrown; Territory of Hawaii. (n.d.) Retrieved from https://www.nvlchawaii.org/hawaiian-monarchy-overthrown-territory-hawaii

The first telescope was built on Mauna Kea in 1970. For the first twenty years there was little opposition to the telescopes on the mountain.[2] However, beginning in the 1990s, the rift between astronomers and the local community began to grow setting the stage for the conflict on the mountain today. 1993 marked 100 years since the overthrow of the Hawaiian monarchy and activism in regards to Hawaiian sovereignty issues began to emerge. Soon after, President Clinton signed an apology resolution, which formally apologized for the overthrow of the monarchy and annexation of Hawaii. Environmental groups also began to oppose the telescopes as they disrupted an environment home to countless endangered species. The biggest blow came from an audit of the management of Mauna Kea in 1998. The audit states,

> We found that the University of Hawaii's management of the Mauna Kea Science Reserve is inadequate to ensure the protection of natural resources. The university focused primarily on the development of Mauna Kea and tied the benefits gained to its research program…The university's control over public access was weak and its efforts to protect natural resources was piecemeal. The university neglected historic preservation, and the cultural value of Mauna Kea was largely unrecognized.[3]

When Hawaii was annexed, the lands of the Hawaiian Monarchy were ceded to the US government. After statehood, these lands were transferred to the control of the government of the State of Hawaii. These lands were supposed to be used to support the betterment of native Hawaiians. The 1998 audit made it clear that the University of Hawaii (UH) had failed to use Mauna Kea in a way that served the native Hawaiian community.

[2] Ciotti, J. E. (2011). Historical Views on Mauna Kea: From the Vantage Points of Hawaiian Culture and Astronomical Research. *Hawaiian Journal of History*, *45*, 147–166. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=67629184&site=ehost-live&scope=site

[3] State of Hawaii. The Auditor. (1998). *Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve: A Report to the Governor and the Legislature of the State of Hawai'i.* (98-6). Office of the Auditor

Case For and Against the TMT:

In this section I plan to discuss both the case for and against the TMT. Again, the goal is not to take a side, but to accurately describe the positions of each side, which will allow a deeper study and understanding of the issues.

As the name implies, the TMT is a very large telescope with a thirty meter diameter mirror. According to project supporters, this will allow the TMT to produce images with twelve times the resolution of the Hubble Space Telescope.[4] The telescope will allow astronomers and physicists to better understand star and planet formation, as well as the history of the universe. In my final draft I plan to go into more detail on the technology of the TMT. TMT organizers are also considering a secondary site in the Canary Islands if the project cannot be built on Mauna Kea. A discussion of alternate sites as well as the factors that make Mauna Kea ideal for astronomy will be included in my thesis.

According to organizers behind the TMT, the project has held public meetings and engaged in "open dialog and meaningful discussions with community members and stakeholders to better understand the island's issues as well as the cultural and natural significance of Mauna Kea." The TMT has also pledged $1 million per year for STEM education in the community. The construction will also create 300 jobs and the telescope will employ about 140 employees.[5]

According to the International Astronomical Union (IAU), the study of astronomy is important as it leads to advances in technology and STEM education. It also states that astronomy is about answering fundamental questions such as, "What is the fate of the universe?". It goes on to say that, "pursuing these questions is a fundamental part of being human."[6] I also

[4] About. (n.d.) Retrieved from https://www.tmt.org/page/about
[5] The Process. (n.d.). Retrieved from https://www.maunakeaandtmt.org/tmt-process/
[6] About the IAU. (n.d.) Retrieved from https://www.iau.org/administration/about/

have interviewed Shane Davis, an astronomy professor here at UVA, on why astronomy is important and why it should be studied. Material from this interview will be included in my thesis.

In an article titled Historical Views on Mauna Kea, the author writes,

> The astronomers' clinical view of the summit's use was pragmatic and altruistic. It was couched in academic idealism. Surely, such a pure, intellectually-minded endeavor was evidence enough to persuade all of the summit's strategic value. Besides, the summit's astronomical discoveries mirrored the explorations of ancient Polynesian navigators. From the vantage point of the astronomers, the horizon is a barrier to be pushed back—beyond which new frontiers lie. Certainly, all people share astronomy's noble quest—to discover our origins and place in the universe.[7]

This view is not necessarily wrong, but it leads to conflict with local communities, who often have other priorities.

In 2015, the IAU conference was held in Honolulu, HI. Protestors shared three key arguments against the TMT: environmental impact, cultural impact, and lack of prior and informed consent.[8] I plan to address the environmental impact and the cultural impact.

According to the same article,

> In contrast, the community's cultural view of the mountain was steeped in heritage and spirituality. It was charged with the latent resentment of a disputed overthrow. Surely, such long-held, culturally minded beliefs were enough to exhort all of the mountain's sacredness. Besides, the summit's pristine majesty reflected the unspoiled, untouched wonders of outer space. From the viewpoint of the Hawaiian culturalists, the horizon is an embracing shelter within which heritage is safeguarded. Certainly, all people are mindful of traditions—to preserve our origins and genealogical connections with the sky.[9]

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[7] Ciotti, J. E. (2011).
[8] Martin Lopez, Alejandro. (2018). Peoples Knocking on Heaven's Doors: Conflict Between International Astronomical Projects and Local Communities. *Mediterranean Archaeology & Archaeometry, 4, 461-468.*
[9] Ciotti, J. E. (2011).

It is important to not mistake being against the TMT for being against astronomy, science, and technology. A protestor interviewed for a Nature article says, "We are fighting for the rights of the mountain. I have nothing against astronomy, just don't put it [the TMT] up there [on Mauna Kea]."[10] Marie Brown, a professor in the UH Department of Religion notes that, "Unlike adherents of Christianity or other major world religions, we [Native Hawaiians] are asked to justify our beliefs, demonstrate the authenticity of our traditions, and prove that (it) is a valid religion."[11] I plan to do more research and analysis of the sacredness of Mauna Kea in Hawaiian culture and religion.

Another point often brought up by critics of the TMT is mismanagement of Mauna Kea by UH. The Office of Hawaiian Affairs (OHA), a public agency responsible for improving the well-being of Native Hawaiians, filed a lawsuit arguing UH breached the terms of its lease of Mauna Kea.[12] In my thesis I will go into more detail about the lease structure and environmental issues regarding telescopes on Mauna Kea.

STS Framework:

I plan to use the concept of Utilitarianism to examine to conflict on Mauna Kea. Utilitarianism is the view that the morally right action is the action that produces the most good. Impartiality and agent-neutrality are also important concepts in utilitarianism.[13] One party's good is not more important than another party's good. Considering this though, it is very hard, if not

[10] Witze, A. (2015). The mountain-top battle over the Thirty Meter Telescope. Nature, 526(7571), 24–28. https://doi.org/10.1038/526024a
[11] Brown, M. A. (2016). Mauna Kea: Ho'omana Hawai'i and Protecting the Sacred. *Journal for the Study of Religion, Nature & Culture*, *10*(2), 150–169. https://doi.org/10.1558/jsrnc.v10i2.27795
[12] Mauna Kea. (n.d.). Retrieved from https://www.oha.org/maunakea/
[13] The History of Utilitarianism. (2009). Retrieved from https://plato.stanford.edu/entries/utilitarianism-history/

impossible, to have a neutral body making decisions. The IAU attempts to frame itself as "neutral", but they cannot be considered neutral when the goal of the organization to promote the study of astronomy. Nobody can deny the scientific, academic, and economical benefits that the TMT would bring and it is important to also consider the astronomers and physicists whose research depends on being able to use the TMT to observe the universe. However, it is important to note that the "good" of the protesters is the protection of Mauna Kea, which is considered sacred. In this context I believe it is worth exploring who (or what) gets to decide the course of action.

Related to this, I will also consider opinion polls regarding support for the TMT. A poll conducted in August 2019 showed that 64% of registered voters in Hawaii support building the TMT on Mauna Kea. However, the same poll shows that 48% of people who are Hawaiian by ethnicity oppose the TMT while only 44% of the same group of people support it.[14] I will attempt to analyze this using the Utilitarianism framework. This leads to important questions to analyze, such as should a majority of people decide what happens or should a majority of Native Hawaiians decide what happens? I think it would also be important to analyze what the majority gains by building or not building the TMT and the impacts on the minority group.

In addition to using Utilitarianism to analyze whether the TMT should be built, I also plan to use the idea of a trading zone to analyze whether the gap between the protestors and astronomers can be bridged. A trading zone describes how two groups of people who speak from vastly different theoretical, cultural, or practical perspectives can come together and have a

[14] Blair, Chad. (2019). Civil Beat Poll: Strong Support for TMT but Little Love for Ige. Retrieved from https://www.civilbeat.org/2019/08/civil-beat-poll-strong-support-for-tmt-but-little-love-for-ige/

meaningful interaction and dialogue.[15] A trading zone could be particularly helpful in the TMT case where it seems that the astronomers and protesters have vastly different practical and cultural perspectives. However, if the protestors are unwilling to compromise, than a trading zone may not be all that useful. I think it would also be worth discussing the conversations TMT organizers say they have already had with local people.

Technical Topic Overview:

The goal of our capstone class is to use a mechanical means to recharge batteries. We live in a world in which access to electrical power is extremely important. Electrical power is important for lighting and electronics among other things. Our group decided to focus on providing power to be able to recharge a cell phone. Current cell phone technology can be used for communication and entertainment, and can also be utilized as a flashlight, clock, etc… Given the importance of cell phones in everyday life, we thought it would be important to have easy access to power our cell phones.

Our project consists of a device that is able to be clipped to a bike. A small wheel in contact with the back wheel of the bicycle will spin a motor that will be used as an electric generator. The power will then be stored in a battery. We are also designing a mount to hold a cell phone and the battery. This attachment will be able to clip on to the handlebars to allow the user easy access to their phone while riding their bike.

This device is useful for people who ride bikes consistently such as college students or people who live in large, traffic congested cities. It would allow users to charge their phones. It

[15] Gorman, Michael, E., & Werhane, Patricia, H. (n.d.) Using Trading Zones to Prevent Normalized Deviance in Organizations. 245-264.

would also allow users to use their phones for navigation in a safe manner. Users would not have to hold their phone, meaning they could keep two hands on the handlebars.

Our capstone class is two semesters long, so at this point I am not exactly sure what our technical report will entail. As a result, this section may change over the course of this semester and next semester. I will also note that my analysis of the conflict over the construction of the TMT has nothing to do with my technical project.

Conclusion:

The TMT serves as a cautionary tale not only for future telescopes, but any scientific pursuit that requires infrastructure on the ground. While the TMT is not solely to blame for the current protests, a better understanding of the issues at hand and more dialogue with community leaders might have been able to avoid the current situation. Both formal and informal dialogue is important in mitigating differences and trading zones can be a good way to facilitate discussion. Utilitarianism in theory seems like a good way to make decisions, however, it fails to consider the harm that would come to minority groups by making a utilitarian decision. Political leaders and supporters of the TMT hope that the telescope can be built while recognizing and protecting Native Hawaiian beliefs. It remains to be seen whether the TMT will ever be built on Mauna Kea.

Works Cited

About. (n.d.) Retrieved from https://www.tmt.org/page/about

About the IAU. (n.d.) Retrieved from https://www.iau.org/administration/about/

Blair, Chad. (2019). Civil Beat Poll: Strong Support for TMT but Little Love for Ige. Retrieved from https://www.civilbeat.org/2019/08/civil-beat-poll-strong-support-for-tmt-but-little-love-for-ige/

Brown, M. A. (2016). Mauna Kea: Ho'omana Hawai'i and Protecting the Sacred. *Journal for the Study of Religion, Nature & Culture*, *10*(2), 150–169. https://doi.org/10.1558/jsrnc.v10i2.27795

Ciotti, J. E. (2011). Historical Views on Mauna Kea: From the Vantage Points of Hawaiian Culture and Astronomical Research. *Hawaiian Journal of History*, *45*, 147–166. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=67629184&site=ehost-live&scope=site

Gorman, Michael, E., & Werhane, Patricia, H. (n.d.) Using Trading Zones to Prevent Normalized Deviance in Organizations. 245-264.

Hawaiian Monarch Overthrown; Territory of Hawaii. (n.d.) Retrieved from https://www.nvlchawaii.org/hawaiian-monarchy-overthrown-territory-hawaii

Martin Lopez, Alejandro. (2018). Peoples Knocking on Heaven's Doors: Conflict Between International Astronomical Projects and Local Communities. *Mediterranean Archaeology & Archaeometry*, *4*, *461-468.*

Mauna Kea. (n.d.). Retrieved from https://www.oha.org/maunakea/

State of Hawaii. The Auditor. (1998). *Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve: A Report to the Governor and the Legislature of the State of Hawai'i.* (98-6). Office of the Auditor.

The History of Utilitarianism. (2009). Retrieved from https://plato.stanford.edu/entries/utilitarianism-history/

The Process. (n.d.). Retrieved from https://www.maunakeaandtmt.org/tmt-process/

Witze, A. (2015). The mountain-top battle over the Thirty Meter Telescope. Nature, 526(7571), 24–28. https://doi.org/10.1038/526024a

Sources That May Be Used in the Future

Sanders H., Gary. (2013). The Thirty Meter Telescope (TMT): An International Observatory. *Journal of Astrophysics and Astronomy, 34, 81-86.*

Squires, Gordon. (2019). TMT: We Need a Way Forward for All. *Hawaii Tribune-Herald.* Retrieved from https://www.hawaiitribune-herald.com/

Tremblin, P., Schneider, N., Miner, V., Durand, GA., Urban, J. (2012). Worldwide Site Comparison for Submillimeter Astronomy. *Astronomy & Astrophysics, 548, http://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=5&SID=8DUPQabvkXXJXOyHFPc&page=2&doc=11*