Prospectus

Amateur Radio Cubesat

(Technical Report)

Zoning and Land Use in Shenzhen

(STS Research Paper)

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Introduction

The STS team is looking at how zoning in Charlottesville can be a more open process so that it is not used as a way to break up or dislocate local communities. The growth and changes in the city of Shenzhen over the past 40 years make it an interesting example to look at for how zoning and land use can impact communities and a city, as well as what sorts of factors influence the zoning. That will be the focus of this research.

The technical report is unrelated to this, and will look at the plans of a team of primarily aerospace students to design an amateur radio communication satellite which will serve the purposes of providing communication, allowing images to be taken from space, and demonstrating UVA's capability to develop and operate cubesats.

Technical Report: Amateur Radio Cubesat

The primary objective of this project is to build and operate a satellite system that is able to reliably communicate, over amateur radio frequencies, with both a UVA ground station and other amateur radio ground stations around the world. In addition to its use for UVA students, it will also act as a voice relay for the amateur radio community, and will have at least one camera that can be used to take pictures of the Earth. As part of the objective of this mission is to demonstrate UVA's ability to establish reliable communication with a satellite, the mission must have a particularly low chance of failure, which will drive a number of design choices, in particular, the decision to use primarily commercial-off-the-shelf (COTS) components that have existing flight heritage. Additionally, the project must be completed with a budget similar to, and preferably lower than, the last two cubesat projects done at UVA (approximately $60,000). (Bergmann et al., 2019)

The satellite will nominally be operated from the ground station at UVA; however, because it will communicate on amateur radio frequencies, any amateur radio ground station can also communicate with it, which will provide both backup communication in case of an issue with the UVA ground station and the ability to communicate with the satellite at almost any point in its orbit. These additional capabilities will help to improve the reliability of the mission, as well as opening up additional options for functionality, such as beaconing, where the command to stop beaconing must be able to be sent quickly to the satellite. (Bergmann et al., 2019)

The current, very initial, design of the spacecraft is a 1U (10 x 10 x 10 cm) cubesat with two different radios, a primary command radio that will also transmit images from the camera, and a secondary radio that will be used for voice forwarding and backup communication. The majority of the components will be COTS, with the primary student made component being the software that will operate the spacecraft. It will be designed to launch off of the NanoRacks launcher on the ISS, and to fly under a NASA program to help reduce cost. This will also put it into roughly the same orbit as the ISS, which gives it desirable parameters for this application, in low Earth orbit with an inclination around 52°, giving it fairly good coverage and ensuring it flies over UVA fairly often. (Bergmann et al., 2019)

The timeline for the project puts the satellite launching in two years, with the concept, preliminary, and potentially critical design happening in the spring, and the remainder of the time being used to finish the design, build, and test the satellite, and to acquire all necessary licenses to operate it. Because the design spans multiple years, it will be passed off to a different class of students during the coming spring and over the summer to ensure it is able to be completed. (Bergmann et al., 2019)

STS Thesis: Zoning and Land Use in Shenzhen

Changes to zoning, or land use rights, can have a significant impact on communities in a city, such as splitting communities up or reducing the availability of affordable housing, and as a city grows, those changes can become more and more impactful and happen on a larger scale. Given the trend of rural populations moving into cities, it is critically important to look at strategies to allow cities to continue to grow without destroying their existing communities. A prime example of this is the Chinese city of Shenzhen, located right next to Hong Kong, which has undergone astonishingly rapid growth in the past few decades that has led to dramatic changes in the community fabric of the city (Qian et al., 2015). To look at influences on zoning and how it affects communities, this paper will look at Shenzhen through the lens of the benefits and detriments to different social groups, and how those have changed in the years since it was declared China's first Special Economic Zone (SEZ) in 1980.

Literature Review

After the city, originally a small fishing village, became a SEZ, a sudden influx of foreign investment and industry into the city led to a corresponding influx of migrants from other regions of China (Qian et al., 2015). With an increase in the population, there was a significant demand for additional housing, which created an economic incentive for farmers (previously one of the largest groups in the city) to convert much of their land into affordable housing, industrial and commercial buildings, and a number of other uses. These areas became Shenzhen's 320 or so "urban villages", a common site in growing Chinese cities, and an important part of both their cultures and economies (Hao et al., 2012). This development was allowed by the city, along with a great deal of additional construction in these villages that was less than strictly legal, because it contributed significantly to the economic growth of the city, and to the city's income as it sold land use rights (a major source of income for many Chinese cities, in some cases accounting for as much as 50% of their income (Qian et al., 2015)) to the farmers turned landlords (Hao et al., 2012).

Around 2005, the city began to curb its rapid growth (Qian et al., 2015). It had grown by 891 km^2 from 1987 to 2005, and much of the developable (as well as arable) land had been consumed, as can be seen in Fig. 1 (Qian et al., 2015). Shenzhen implemented a number of policies inspired by other major cities around the world, adapted for local use, to accomplish this, but two of the biggest changes were a transition from a primarily land use rights sales income to an income tax based income for the city and an encouragement of vertical over horizontal growth (Qian et al., 2015). With this change, there was a significant push to redevelop parts of the city, including the urban villages, to make more efficient use of already developed land. Rather than expropriating the land used for these villages, the city, in 2009, enacted policies that, among other things, encouraged developers to work with the existing land owners and residents to come to an agreement on how to move forward, with the local government acting only as a mediator and an enforcer for whatever contracts the other parties agreed on (Qian et al., 2015). Additionally, these policies allowed a certain portion of the structures on the land to be illegal, to make up for the city's previous overlooking of illegal development (Qian et al., 2015).

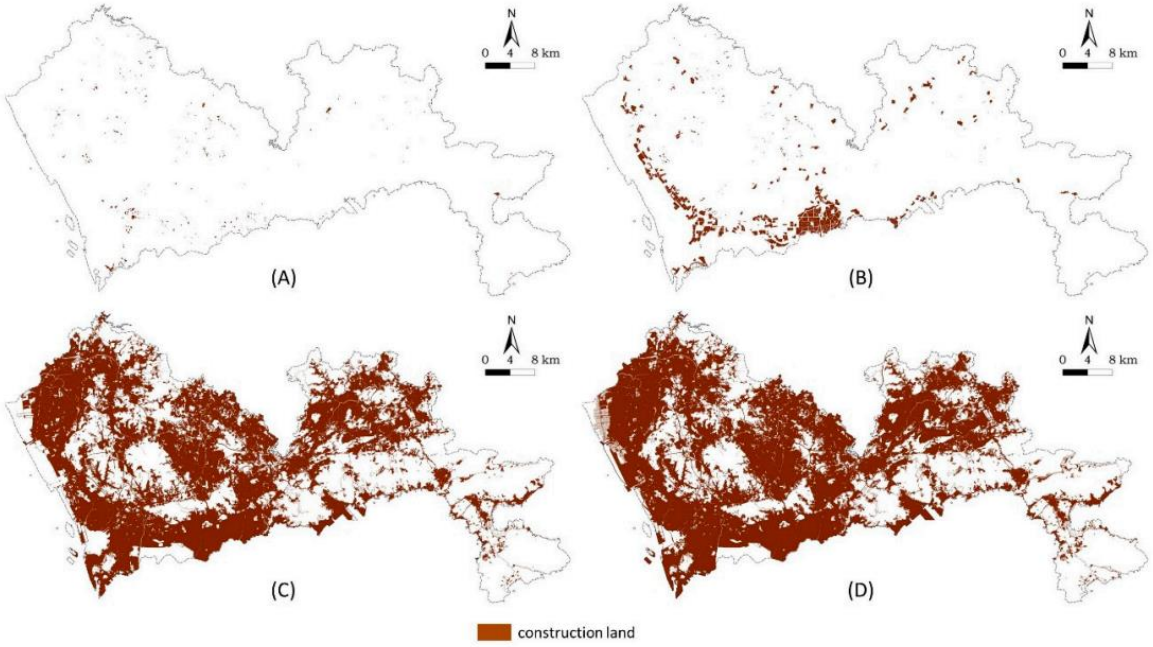

Figure 1 - The evolution of Shenzhen construction land: (A) 1979; (B) 1986; (C) 2005; and (D) 2014 (Qian et al., 2015)

Framework and Methods

To help explore this topic in more depth, a framework is needed to provide a lens through which to assess it. Two options lend themselves well to this particular situation: Social Construction Of Technologies (SCOT) and Social Construction Of Target Populations (SCOTP). SCOT provides a way to look at the interactions between different groups, technologies (in this case, primarily the land use regulations), and the different issues each group faces. While this provides an overview of the interactions, it does not show the social interactions between groups, and in particular power dynamics. That is where SCOTP is useful, it shows which groups are more or less favored by looking at policies and outcomes. A combination of these two should produce a succinct but valuable map of the changes in land use.

Making use of these two frameworks will require more information than can be obtained solely from the documents used here. A review of historical land use maps, population data, policies, and the views of residents of Shenzhen will be needed to build an understanding of the history here.

Conclusion and Next Steps

Shenzhen presents itself as a fascinating case study for how land use can both create and affect communities, and how it can change over time, especially in a rapidly growing city. There are many more factors and outcomes to look at, including how the actual residents of these urban villages have felt about redevelopment, how much of a say have they really had in it, and how much influence has the central government of China exerted on the city? These questions, and especially the first two, are set to be the primary foci of further research into this topic, so that we can gain a better insight into what the effects of growth and change have been on the city at a local level, and what lessons other developing cities can take away from Shenzhen. To provide a map to these problems, a set of diagrams will be produced

using the frameworks mentioned earlier that will show the development of socio-technical interactions and power dynamics around land use in Shenzhen at several points in its recent history.

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