Satellites in the developing world

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MIT PhD candidate Danielle Wood examines the many ways in which developing countries invest in satellite technology. Photo: Jonathan Wood

Within 24 hours of the catastrophic 2010 earthquake near Port-au-Prince, Haiti, space agencies and companies around the world tasked satellites with providing free images of the earthquake's aftermath. Experts quickly analyzed and interpreted images taken from space, mapping out essential information for rescue workers on the ground: areas with many damaged buildings, roads likely closed by debris.

The information was provided through an international charter under which satellite operators around the world offer to share satellite data after a natural or man-made disaster. But now, a number of developing countries are taking steps to build their own national satellite programs, seeking more control over remote-sensing data to map and forecast

disasters, monitor crop yields and track environmentally driven diseases such as malaria.

In a paper published recently in the journal *Acta Astronautica*, Danielle Wood, a PhD candidate in MIT's Engineering Systems Division, and Annalisa Weigel, assistant professor of aeronautics and astronautics and engineering systems at MIT, examine countries including Nigeria, Malaysia and Thailand where nascent satellite programs have cropped up, thanks to a relatively recent philosophical change within the space industry.

"For the first few decades [of space exploration], satellites and their components were considered sort of craft items … they were built one-off, maybe two, and there were no assembly lines for space products," Wood says. "This philosophy of specialized space technology meant it would always be expensive, and limited to a small group" of nations.

Wood says this philosophy began to shift in the 1980s and '90s, when small companies and university-based groups started to explore the idea of building smaller, cheaper satellites from everyday electronics. The University of Surrey, one of the leaders of this movement, eventually spun out a company that today sells small remote-sensing satellites — "the size of a small refrigerator," Wood says — to companies and government organizations. The company also offers training to countries including Nigeria, Turkey and Algeria, all of which have sent engineers to the United Kingdom to build and bring back a satellite.

"These countries are not just getting a new technology toy," Wood says. "They're also creating a new, first generation of experts that can help inform the country's use of space technology to address local challenges."

Those national experts, according to Wood, can go on to educate other

countries, as was the case with South Korea. In the early 1990s, that country was one of the first to send engineers to Surrey to build satellites. South Korea has since cultivated a national satellite program, and has gone on to train engineers from other developing countries.

“Having learned from England, they are now training Malaysia and Dubai,” Wood says.

“Developments such as these make it possible to develop a small satellite for the cost of a few tens of thousands of dollars,” adds Werner Balogh, program officer for the United Nations Office for Outer Space Affairs. “This has further widened the space for possible new space players.”

Exit strategy

However, a growing number of space players means an increasing number of satellites launched into orbit, and Wood says the international community is looking into ways to deal with the resulting congestion. She notes that the United Nations Committee on the Peaceful Uses of Outer Space has established a working group to address this challenge at the international level.

More satellite-launching nations could also create another problem: space debris. As satellites become cheaper to build, countries may choose to launch smaller satellites more frequently, potentially creating extraterrestrial clutter. Wood says developing countries entering the space industry will have to design satellites with an exit strategy in mind.

“If you’re going to put a satellite in space, you have to save a little fuel to make sure you can push yourself back toward Earth, because if you plan it correctly, the satellite will come back into the atmosphere and actually burn up into harmless pieces,” Wood says. “Just as with waste management on Earth, you have to plan for what you’re doing with the

trash at the end."

Planting the satellite seed

As developing countries take their first steps into the satellite field, Wood says they will face many technical, social and political decisions. For example, each country will have to decide how it wants to use its satellites. Technical specifications and the types of instruments onboard will vary, depending on a country's societal goals: whether it wants to monitor dust storms, measure rice yields or track population migrations.

Nations may also decide to partner with foreign governments or companies for assistance in building a satellite program from scratch. And while countries have the option of simply buying a satellite from an existing firm, Wood and Weigel note there are long-term advantages to building technical capacity within a developing country. The more technical expertise a country can gain, the more that experience can help to advance a nation's development overall.

"I have a strong appreciation for the processes governments go through in wrestling with technical issues," Wood says. "I want to make sure my work somehow contributes to improving the lives of people."

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