
会議
KAIGI

Science and Technology Council

Research Packet

Meet the Heads of Council

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Hello and welcome to the Science and Technology Council! I am absolutely honored and thrilled to be chosen as one of the Heads of Council for KAIGI 2018.

I've always been fascinated by technology, particularly in the aerospace industry. The universe is a vast and peculiar place. Our understanding of the universe is limited, but the mystery is a part of what attracts me to them. The world that I live in now is so complex that I sometimes wonder about the wild possibilities we could achieve. Robert Goddard is considered by scientists to be the father of modern propulsion systems, a genius for invention. Who would have thought about this? Strapping a couple of people in a long metal tube surrounded by flammable liquid and blasting off with a speed more than 20 times the speed of sound? Only a madman. And yet, all of this happened. Science fiction became a reality when we broke through the stratosphere, embarking on a journey, a journey whose destination is unknown.

Space is known as the final frontier for a reason. Humans, without evolving further, will not be able to conquer space. Earth is just a tiny speck of dust in the vastness of the cosmos, from this speck of dust, however, we continuously strive to understand other specks of dust in the endless clouds of dust we call the universe. Are we really alone?

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Thank you for choosing to take part in KY KAIGI 2018! We, the Science and Technology Council hope that it will be an insightful event for all that are joining as delegates or spectators.

A dreamer. Imagines a future with probably quite high prospects, we'll see how it goes. Technology? Living in the 21st century with ever accelerating technological advancements. Have always been intrigued by cars and their combustion engines, personal favorite would be Lambo's naturally aspirated V10 engine. But when the Tesla debut their roadster, something sparked. A fully electric car has been able to be at par and even surpass some of the best combustion engine cars in the world. A gearless car with no drivetrain?! Oh, it also comes with a frunk, check it out if you haven't heard of it. Oh yeah, full automation a.k.a self-driving cars is also a thing.

Tesla was behind this innovation. A start to the future of transportation. What else will we be able see in this next century?

Overview / Introduction

50 years ago, outer space was reserved for the most powerful of nations, the most dominant governments. But today, there's a democratization of space. Commercial industry is inching us closer to the cosmos, and in the process, there's a growing interdependence between what's happening hundreds of miles up in space and down below on Earth.

Humans have been utilizing natural resources found abundantly throughout the dawn of mankind. Researched and scrutinized so humans can use them to satisfy humankind's needs. These resources can be either renewable or non-renewable, and the latter is the one that will be discussed. Metals and minerals such as gold, mercury, titanium, iron, cobalt, nickel, copper and so on are examples of non-renewable resources.

The industrial revolution changed everything. The manufacturing industry has grown larger than before, and output is increasing exponentially. However, Earth's resources are finite. Key elements for machinery and rare earth metals are soon to be exhausted. The solution is simple, asteroid mining. With the rise in commercial space companies, this concept is becoming more feasible and practical. Could this be the solution to Earth's resource problems?

The topics that will be touched on in this research packet will be majorly but not confined to the prospects of obtaining these resources from space. The possibilities, risks, costs, management, issues and other direction of thought to bring back valuable resources from space back to earth are essential to decide whether space programs are the way to go or not. Private space exploration companies such as SpaceX and Blue Origin have paved the way to reach into space with much less costs as compared to previous launch programs.

Years are still to come even if asteroid mining is deemed viable and companies and nations start to catch the next gold rush. Meticulous researches must be conducted in not just science but also social policies as current laws prohibit land claims on extraterrestrial lands. More complications will surely arise as we dwell into the lands of the unknown.

Status quo / current affairs

You can see it globally, how humans have advanced in the past century. How fast technology has grown and been so deeply integrated into our lives that you're probably reading this on a machine that didn't even exist 100 years ago. Technology has paved our way to great leaps into depths of knowledge. But all good things come with a cost. While we can enjoy our luxurious eased life, there has been environmental consequences to Earth. Human advancement has changed the face of the Earth. If such big implications are because of humans, then should we really be venturing into extraterrestrial territory?

Not just that, if we are to venture into space and claim territory rights, what would be the means? This isn't Star Wars where there is a galactic republic to regulate laws. Who knows what will happen if someone is one day able to gain access to means of obtaining resources in space to themselves and monopolize. Will there be prompt responses to the moment of eureka? And if so, are they able to regulate and have power and control over these space pioneers. As it stands today, there is no detailed rulings over how to claim extraterrestrial bodies.

Someone who is interested in technological advances must have heard of the name Elon Musk. CEO of Tesla Motors with the first long range, all electric car. Elon Musk also owns another company, SpaceX. Their mission is to become the world leader in offering reduced cost for space travel as compared to national agencies. Initiative has been taken by companies like SpaceX, Blue Origin, Virgin Galactic and others in exploring extraterrestrial bodies. These companies are investing into space exploration for possibilities of returns in future advancement of humankind.

Case studies

The Rosetta mission

On 2 March 2004, the European Space Agency (ESA) launched a satellite probe named Rosetta to perform a detail study on comet 67P/Churyumov–Gerasimenko (67P). Its main mission was to investigate the nucleus of the comet and to gather organic compounds for analysis. After 10 years, on 6 August 2014, the spacecraft reached the comet and performed a series of burns and it eventually managed to orbit the comet. A few months later, in November, its lander, Philae performed a successful landing on the comet. However, due to complications on landing, Philae settled down under a large overhang. This made it unable to adequately collect solar power, and its batteries ran out after two days, well before much of the planned science objectives could be attempted.

> *"All stations and the briefing room, we've just had loss of signal at the expected time. This is another outstanding performance by flight dynamics. So, we'll be listening for the signal from Rosetta for another 24 hours, but we don't expect any. This is the end of the Rosetta mission. Thank you, and goodbye."*
> *—Sylvain Lodiot, Rosetta Spacecraft Operations Manager, European Space Operations Centre*

Although short lived, the mission has yielded a significant science return, collecting a wealth of data from the nucleus and its environment with a various level of cometary activity. At the end of September 2016 after two years of operations at the comet, Rosetta began a 19 km descent with a 208-second thruster burn executed on 29 September 2016. Impact occurred 14.5 hours after its descent maneuver, marking the end of the 12-year mission.

ESA's website: http://sci.esa.int/rosetta

Hayabusa and Hayabusa2

Launched and operated by the Japanese Space Agency (JAXA), Hayabusa was a robotic spacecraft developed to return a sample of material from a small near-Earth asteroid named 25143 Itokawa to Earth for further analysis. The spacecraft was launched on 9 May 2003 and rendezvoused with Itokawa in September 2005. In November 2005, it landed on the asteroid and collected samples. The mission was successful, and the probe returned to Earth on 13 June 2010. Its predecessor, Hayabusa2, was launched on 3 December 2014 and rendezvoused with asteroid 162173 Ryugu on 27 June 2018. It is scheduled to survey the asteroid for 1.5 years, before returning to Earth in December 2020. Hayabusa2 features improved technology such as ion engines and an improved re-entry capsule.

> *"Preliminary observations "are really thrilling," says Seiichiro Watanabe, a project scientist at Nagoya University in Japan. The diamond-shape asteroid is about 900 meters across and rotates around its own axis every 7.5 hours or so, more slowly than other similarly sized asteroids for reasons that are not yet clear, Watanabe says."*

From MIT's website:
(http://web.mit.edu/12.000/www/m2016/finalwebsite/solutions/asteroids.html)

Planetary Resources and the Keck Institute for Space Studies (KISS) have independently conducted feasibility studies for asteroid mining and retrieval ("Asteroid Mining Venture", 2012) & ("Is Asteroid Mining Possible?", 2012). Japan conducted a successful sample return mission to the asteroid Itokawa, an important stepping stone towards future sample of asteroid retrieval missions (JAXA, 2012). The Hayabusa mission to this asteroid was able to autonomously approach, land on, collect data on the surface and topography, and collect a sample of the Itokawa asteroid and return to earth to drop the sample containing capsule in Australia.

JAXA's website: http://global.jaxa.jp/projects/sat/hayabusa2/

OSIRIS-REx

The OSIRIS-REx (Origins, Spectral, Interpretation, Resource Identification, Security, Regolith Explorer) is NASA asteroid study and return mission. The spacecraft was launched on 8 September 2016 to rendezvous with the asteroid 101955 Bennu. It is expected to return to Earth with samples on 24 September 2023 for detailed analysis. The spacecraft is currently in its cruise phase and will begin its approach phase on 17 August 2018. If this mission is successful, OSIRIS-REx will be the first U.S. spacecraft to return samples from an asteroid.

NASA's website: https://www.nasa.gov/osiris-rex

SpaceX

On September 28, 2017, founder and CEO of SpaceX, Elon Musk gave a keynote to the International Congress in Adelaide, Australia. During the 43-minute talk, Musk laid out SpaceX's future including colonizing Mars and building one rocket to rule them all - the BFR. According to Musk, the BFR will be able to bring humans to Mars and make the return journey using fuel made from Mars's atmosphere. The BFR, would also be able to refuel spacecrafts in Earth's orbit, making space exploration to places beyond our solar system possible. This is crucial in the field of asteroid mining, as it allows more payload, thus making more revenue. SpaceX also launched its heavy lifting vehicle, the Falcon Heavy on February 6 2018 from Cape Canaveral. According to Musk, the Falcon Heavy is able to launch payloads directly to Pluto and beyond without any stops.

SpaceX's website: https://www.spacex.com/

Guiding questions

1. As a head of state of a country, would you spend half of your country's resources and wealth into the research of spacecrafts?

2. Country A deems asteroid X as an ideal candidate of harvesting resources. It devotes time and resources into building spacecrafts capable of mining from this asteroid. Country A's neighbor, country B decides to launch a spacecraft to asteroid X as well. This creates a conflict of interest between the two countries, how will this problem be resolved?

3. How will asteroid mining affect prices of current rare Earth elements?

4. Private company SpaceY intends to launch a spacecraft to a nearby asteroid to harvest its minerals. It wants to use private company Green Origin's rockets to transport their probe. Green Origin draws up a contract and demands 60% of the revenue gained. As a head of state of a country where these companies are based, will you allow this?

5. Do you think the next gold rush will take place in space? If so, why?

6. Company K wants to claim an uninhabited island in international waters, are they allowed to do so?

7. Do you agree with the following quote: "Space: The Financial Frontier"?

Conclusion

The commercial space industry is doing a phenomenal of making access to orbital space commonplace. We're now at a place where launching a satellite to low Earth orbit is unexceptional, and that was our goal, to obtain easy access to space. Getting beyond Earth's orbit though, outside our cosmic neighborhood into deep space, that's still tough.

During the Space race 60 years ago, one could classify it as exploration. However, in the long term, it was an investment that paid off because space, now makes money. Space today is an integral part of what we know and what we can do on the surface of the planet. Imagery, climate science, defense and security applications were seamlessly enabled by space technologies without most of the population knowing about this.

The difference between commercial space enterprise and governments is time. Commercial enterprises need to think about investments that pay off within the lifetime of their shareholders. The innovation that will occur by bringing humans to Mars and beyond will absolutely make money in the very long term. But right now, it will take an enormous amount of money that few people would want to risk.

Once we be careful to realize that this coming era of commercialized space does not necessarily translate into a Renaissance of space exploration, commercial industry is not a substitute for NASA, ESA or other government institutions. They are collaborators. They can make the government's job easier and cheaper, but they cannot replace those whose jobs are to go where no humans has gone before. The next few decades and centuries can be the era of space exploration, but for that, we need a public, that understands anything good, anything truly worthwhile, takes time.

We hope that this research packet prepared for you by the Science and Technology Council will provide you with some degree of help in preparing for the upcoming KY KAIGI. Do make the initiative to research more on this topic and be prepared to share your ideas and views during KY KAIGI.

References & further reading

http://web.mit.edu/12.000/www/m2016/finalwebsite/solutions/asteroids.html

https://www.prindlepost.org/2018/02/spacex-ethics-space-travel/

https://www.wired.co.uk/article/international-laws-are-not-ready-for-space-mining

http://now.northropgrumman.com/asteroid-mining-and-the-gold-rush-of-the-21st-century/

https://www.space.com/30213-asteroid-mining-planetary-resources-2025.html

You are encouraged to do further research and be fully prepared for any situations that may arise during KAIGI 2018!