KAZUO NAKAMURA







What Humanity Needs to Build a Sustainable Society in Space

Creating "Human Space Studies" to Elevate Manned Space Activities in Academia

Kazuo Nakamura

Chairman and CEO, CMIC HOLDINGS, Co., Ltd.



Takao Doi

Graduate School of Advanced Integrated Studies in Human Survivability, Kyoto University Professor

More than 50 years have passed since humanity reached outer space. An increasing number of private companies are engaging in space development, and space is becoming more familiar to us. What does humanity need to achieve sustainable development in space going forward? After participating in two flights as an astronaut, Takao Doi created "human space studies" as a research field to empower humanity to achieve sustainable development in space, and he now teaches at Kyoto University.

CEO Nakamura listened to his experience as an astronaut as well as his philosophy on human space studies.



TAKAO DOI

Retaining a sense of awe at the unknown

Nakamura First, what prompted you to set your eyes on space?

Doi It all started in junior high school when a friend invited me to attend a solar observation session. I got my own astronomical telescope to take photos of constellations and view the planets, and I came to love space. I became more and more engrossed. Nakamura I come from Kofu, and I heard that you also lived in Kofu while in junior high school because of your father's transfer for his work. The Kofu Basin has lush nature and a particularly beautiful starry sky at night, doesn't it? Doi Yes, for sure. I often think about why I came to love space. At the time, space was even more of an unknown realm than it is today. The realm of the unknown is extremely exciting for kids, and it gives them a dream to aim toward. They can imagine lots of things, like what the end of space might be like or whether there are lifeforms and civilizations like ours in space. When I got my own astronomical telescope, I started to see things that I had never known

about before, a little bit at a time. I could observe the Moon's craters, the patterns on Mars, Saturn's rings, and other things that I could not normally see. As a result, I gained more and more knowledge.

Japan's research into rockets was also very exciting for me. On February 11, 1970, the team at the University of Tokyo's Institute of Space and Astronautical Science (founded by Hideo Itokawa) successfully launched Japan's first artificial satellite.

"Ohsumi," after a great deal of effort. At that time, I was in my third year of junior high school. Nakamura So, you were at the most impressionable stage of your life? Doi Yes, that's right. I was deeply

moved when I saw Commander Neil Armstrong walking on the Moon the previous year, and I came to love space even more after seeing Japan successfully launch a satellite with its own rocket the following year. In high school, I decided that I would pursue a career related to space. Ever since, I have maintained that same sense of awe for space that I felt then.

Experiencing the joy of reaching space upon seeing the blue, shining Earth

Nakamura Were you nervous the day before you first left for space? Doi I was confident because I had completed more than a year of training alongside my team, and I also knew the space shuttle's systems very well, so I was trained in how to respond if an issue occurred. As a result, I wasn't nervous at all. Nakamura I see. Did the launch

proceed exactly like how you had trained, with no surprises?

Doi There were no issues. However, I was surprised at how extremely quiet it was during my first launch. When you watch a launch, you usually hear a huge noise upon ignition that makes the ground shake. The rocket sends out gases at supersonic speeds behind it, so hardly any of the tremors make it to the front of the rocket. The solid-propellant rocket engine burns for the first two minutes, so it shakes like a car driving on a bumpy road, but after these engines are cut away, it is quiet with no vibration. G

(gravitational acceleration) slowly increased from there, and my body suddenly felt light after 8 minutes 30 seconds. My body flew up out of my seat, and I truly felt my arrival in space. Nakamura There must be many tasks to do as soon as you reach space. Doi Yes, it is very tough. My first job was to move to the flight deck and take a photo of the detached propellant tank from the window. This was my first time in microgravity, but I managed to get a picture while bumping against the things around me. Nakamura How did you feel when you saw the Earth for the first time? Doi I still remember it vividly. After finishing changing what I was wearing for the first time on the flight, I opened the doors to the cargo bay, and I saw the blue, shining Earth. I was struck by how wonderfully beautiful this planet is. At the same time, as I

looked at the Earth against the contrast of the pitch-black space behind it and saw with my own eyes how the Earth's horizon forms a circle, it really hit me that I had come to space, which moved me deeply.



Holding an artificial satellite in his hands in space

Nakamura How many days did you spend in space? Doi For each of my two flights, I was

in space for 16 days. Nakamura What was your schedule like while you were in space?

Doi The first three days or so are the busiest. This is because we plan to do all the important missions at the start in case an accident occurs and we have to return to Earth.

Nakamura I would imagine that unexpected events may lead to changes in the schedule. Is that the case?

Doi Yes, such a thing often happens in space. On my first flight, the mission that was our main objective did not go as well as we had hoped. For this mission, we needed to release a nearly 1.5-ton solar corona observation satellite named "Spartan" and then collect it. However, we failed to launch it with the right trajectory. After many discussions on-board and with the team on Earth, it was decided that we would retrieve it manually three days later as an extravehicular activity. Nakamura That sounds tough. Did you successfully retrieve it in the end? Doi I stood on the cargo bay together with Astronaut Winston E. Scott, and the two of us held the Spartan satellite from both sides in order to retrieve it. Anything can happen when you go to space. (laughs)

While we were waiting to approach the Spartan satellite, I had some time to gaze into space without any tasks to do. You cannot see the entire Earth from the space shuttle windows, but the helmet for extravehicular activities has a field of vision of nearly 140 degrees, so I could take in the entire globe. It was spectacular and beautiful.

Fulfilling his goal as an astronaut and setting out on a new path

Nakamura After completing your missions in space, how did you feel when you landed?

Doi My mind was buzzing, so I felt full of energy mentally, but my body felt very heavy. I would feel dizzy when I stood up, so I sat on a chair and waited for my body to get acclimated to Earth's 1G environment. At that time, I even felt the weight of a single pencil was heavy. Thinking about it now, I assume that the gain had been significantly reduced with respect to the orders sent from my brain to my muscles; the flight lasted 16 days, so I doubt that my muscles had weakened so much. Because people's bodies have no weight in space, it takes very little force to move. If I exerted my usual level of force, I could not move very well. Thus, my brain automatically reduced the gain, thereby letting me move my muscles using only a minimal degree of force. This is the process of adapting to space. You could say it is like switching one's control system. This switching takes time, so I could not switch back immediately when got back.

However, my sensual perception

KAZUO NAKAMURA

returned to me quickly, and I could walk normally after an hour. Nakamura How long does it take between coming back to Earth and going on the next flight? Doi This varies among people, but in my case, it took guite a long time. Since being selected as an astronaut, it took a whole 12 years for me to have my first flight. The largest reason for this was the Challenger accident in 1986. For my second flight, the launch of Japanese Experiment Module "Kibo" was delayed due to the Columbia accident as well as changes to plans for the International Space Station following a lack of funding from the US. In the end, it took 11 years before I went on my second flight.

Looking back on those long wait times spanning 12 years and 11 years, I appreciate the importance of never stopping my training. It helped me to stay healthy, and it also continued to prevent my abilities from deteriorating. To continue training, you need a strong desire to go to space as well as endurance.

KAZUO NAKAMURA

Nakamura After you finished your second flight, you decided to take a different path instead of remaining an astronaut. What were you thinking at that time?

Doi I had the option to continue training as an astronaut, but I decided to set off in a new direction because I felt that I had fulfilled my greatest personal goal of helping build the International Space Station. I had several choices at that time, such as to return to Japan and instruct astronauts while continuing my research, or to work at a space venture company. In the end, I took the position of Chief of the Space Applications Section of the United Nations Office for Outer Space Affairs in September 2009. I knew a lot about space through my activities as an astronaut, but at the same time I felt that I did not know much about the Earth, which prompted me to apply to the UN. I did not intend to stay at the UN for long, but I was active there for a total of seven years. My main duty was to encourage people in both developed and developing countries to use scientific technologies for spaceyou could call it educational work.



Cutting across multiple fields to create "human space studies"

Nakamura You are now working to create a new academic field called "human space studies." How would you describe this field? Doi When I started to work at Kyoto University in 2016, I wanted to teach the fields that I knew best. The first ideas I thought of were astronautics and astronomy. However, anyone can teach these topics; I thought about what I could teach that no one else could, and I hit upon manned space activities. However, when I tried to actually lecture about this topic, I realized that I was simply talking about my own

experiences in space and that I had not elevated the discussion to the level of academia. In light of this, I decided that my work at Kyoto University would be to make manned space activities into a field of study so that humanity can step out into space.

KAZUO

NAKAMURA

In order to conduct manned space activities on a continuous basis, we must create societies on the Moon, Mars, and other locations away from the Earth. If people only move back and forth between the Earth, the Moon, and Mars, this will not expand space development. A society must form where

a permanent basis. To this end, we need not only astronautics, astronomy, and space medicine but also research in economics, law, literature, and art. Nakamura I understand human space studies in the following way: the time may come when humanity needs to leave the Earth and go to space. In other words, when we consider things over the long term, we identify the possibility that we may encounter a change in the environment whereby we can no longer live on the Earth, just like when humanity shifted its habitat from the plains to the savanna following a loss of forests. What really piques my interest here is the fact that you are taking on the challenge of cultivating plants in space. Plants are essential for people to live on Earth, and this necessity remains true in space. I would love for you to continue research on whether humanity can advance into space and adapt to it, and what type of environment we need to survive.

people can live on the Moon or Mars on

Doi As a matter of fact, at Kyoto University I teach within an educational program that I created to fuse the natural sciences with the humanity and social sciences. Let me give one example of an interesting research topic that I am working on now. As I said earlier, humanity needs to create a society in space in order to achieve permanent development in space. As the first step toward this, we need to think about the necessary conditions for society to exist in space. In this regard, primatology offers some hints. Kyoto University has historically conducted active research on primates. By studying the societies of apes-animals that are close to humans—this field aims to understand

humanity and human societies. When I talked to everyone at Kyoto University's Primate Research Institute, they told me about an interesting study by the British anthropologist Robin Dunbar. Dunbar states that with apes, the number of individuals that form a stable group is proportional to their brain size. By taking this relationship between brain size and the number of individuals in a group and applying it to humans, Dunbar claims that the number of people who can exist as a group without any kind of social system is about 150. This is roughly equivalent to the number of people to whom we send New Year's greeting cards. It is certainly true that we can remember people's names and faces and maintain close relationships in a group of about 150. Thus, the first human society to be formed in space may have 150 people living together. Though there are certainly many other conditions for societies to survive besides the number of people, we incorporate results from primatology in this manner as we pursue research in human space studies.

The hint to beating the virus is in 150-person societies

Nakamura With the current COVID-19 pandemic, there are concerns regarding drops in psychological well-being. Do you have any hints from the perspective of human space studies that can be of help in this regard?

Doi Interpersonal relationships are extremely important in human space studies as well. Even if the current COVID-19 pandemic subsides, in the future there will be similar new viruses. Thus, measures against viruses will be a constant challenge for humanity. Our society has become extremely complex, and we may now perceive some structural weaknesses regarding virus contamination. However, I feel we must bring our minds together and build a society with a structure that is sound against viruses. Our ancestors lived in

"150-person" societies that could remain stable as groups. They faced issues with viruses many times without the benefits of the latest science, and they prevailed each time, so there is certainly an answer therein. This is not a pipe dream at all.

Nakamura When you say the word "society," people commonly think of a large metropolis where people live densely together, but it is important to focus our attention on societies with about 150 people who can respect each other's individuality and understand one another. In this sense, I feel that we can gain many hints by thinking about the process of human evolution. Great apes like the gorilla, bonobo, chimpanzee, and others are still alive today alongside Homo sapiens (modern humans). Since many other kinds of humans such as the



KAZUO NAKAMURA



Neanderthals later went extinct, how did modern humans continue to survive? It is certainly true that vaccines and medicines are necessary to fight viruses that pose a threat to humans, but how should we approach the wisdom that has helped us to survive? By thinking about these questions, we may be able to develop the power to coexist with COVID-19. Going forward, I believe that we will need to adopt a broad perspective with a focus on these points when humans venture into space in the face of global environmental changes and many other issues. Human space studies seeks to build sustainable societies in space, and this field also offers hints toward breaking free from our current circumstances. Thank you for taking the time to talk with me today.