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“Hayabusa” – Journey to Renewal of Japanese Innovation

Interviewer: *Japan SPOTLIGHT* Editorial Section

Our readers must have heard about the successful but occasionally challenging seven-year-long space journey of a small research spacecraft called ‘Hayabusa’ created by a group of Japanese space scientists at JAXA.

After its return from space last year, having achieved its mission to explore a small planet far away from Earth and bring back some specimens, their success story filled with hardships has excited Japanese people.

Japan SPOTLIGHT interviewed Dr. Junichiro Kawaguchi, the program director, on his views on the future of space development, innovation in general, and education.

Through the touching human story of Hayabusa, what we can learn objectively on the future of science and innovation is highlighted below.



Dr. Junichiro Kawaguchi

Potential of Japanese Spacecraft Technology

With the success of this project, Japanese space development technology has proved to be one of the most advanced in the world, hasn't it?

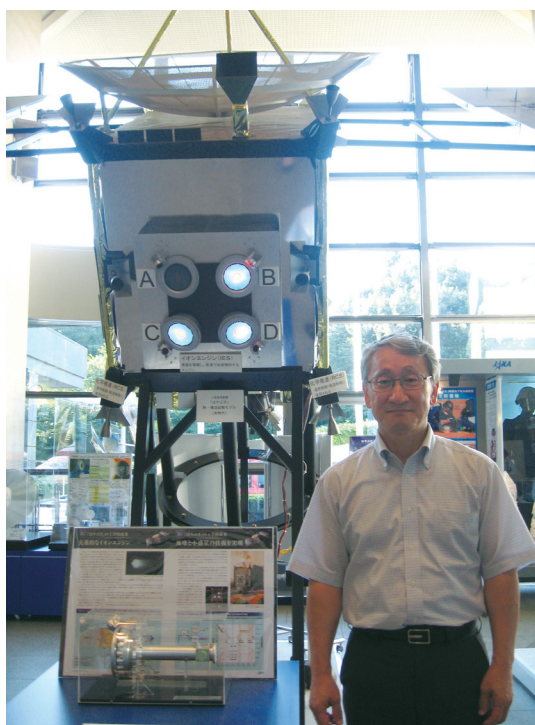
Kawaguchi: Partly yes, partly no. It does not necessarily mean such progress in Japanese technology. The Hayabusa project has achieved the journey of a spacecraft going to an asteroid outside the gravity sphere of the earth and coming back to the earth, which is a completely new attempt by humankind. However, Japanese spacecraft are still heavily dependent on US-made parts and components. The Japanese market for space-related applications is so small that the development of such products does not pay well. Therefore, we inevitably have to use products made in the US, whose safety is assumed because of actual flights.

Above all, space technology development is an extremely difficult business. Each trial and error improves the quality of a product. However, each trial costs an enormous amount of money. After an error, we need to spend much time studying the possibility of another trial in order to avoid too much cost for a retrieval. That prolongs the lead time for a project and thus results in increased labor costs.

We cannot afford to make more than one single spacecraft for the mission and have to use even the same one that was used in a test, for real. It is extremely difficult to achieve success with only this one spacecraft hardware, whilst we could even have a failure among one million cars produced.

Any sponsor or government would be reluctant to pay much more for accomplishing the project and would still require us to succeed, which would compel us to make hard decisions.

We often hear that Japanese space missions frequently malfunction. This is because of such a difficult situation



Kawaguchi with a large-scale model of Hayabusa

in relation to the production circumstances connected with the space business in Japan.

Compared with the technological progress of the US in this domain, Japanese technological progress is fairly limited due to such circumstances. Japan's level of technology is not so advanced whereas in the US engineers are given more opportunities for testing and thus spacecraft credibility can be increasingly improved.

It is occasionally pointed out that Japanese perfectionism in the extreme details of any activity including the development of manufacturing technology could contribute to the progress of technology related to artificial space satellites. What is your view?

Kawaguchi: I do not think that Japanese perfectionism contributes to the technological progress of space satellites. Instead, this perfectionism, in other words, the fear of making an error, born from the Japanese cultural and social background, seems to close the door to innovation such as creating a new product or challenging a new frontier. That is a principal reason why our space technology remains at a fairly low level.

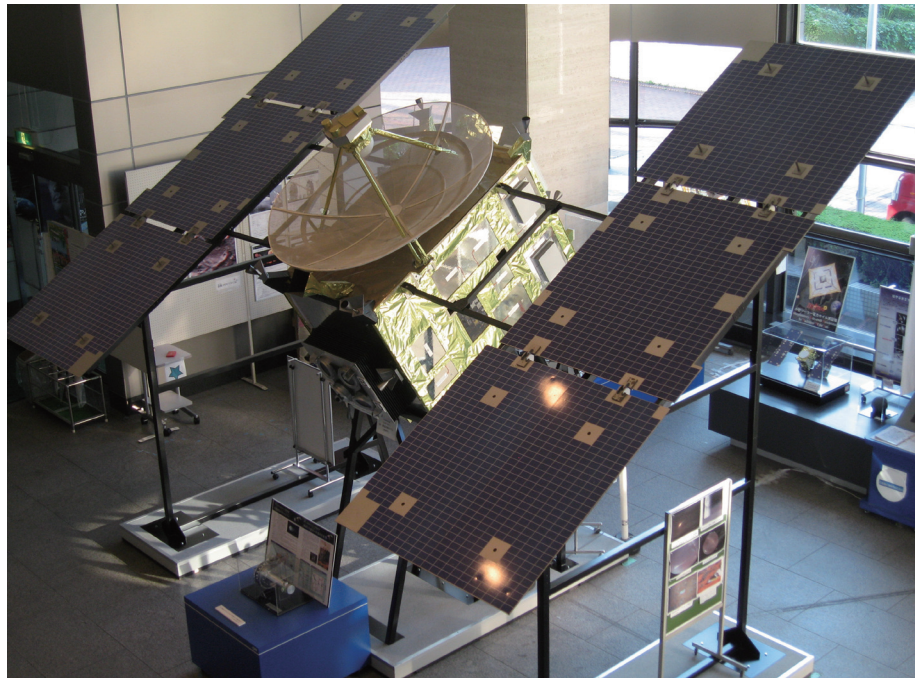
International Collaboration on Space Development

Do you think international collaboration is important in such a large-scale technological development as a spacecraft in order to overcome national weaknesses through learning from each other among a variety of partners?

Kawaguchi: We can perhaps reduce the risk of a large investment project through an international collaboration. However, much more importantly, we need to think about how this international collaboration could contribute to our nation's national welfare.

It is certainly true that in terms of project cost, international work-sharing would reduce the risk significantly. However, a country should always keep in mind that a national science and technology policy pursuing international cooperation should aim at raising the level of the country's technology. Otherwise, international cooperation would mean nothing but the subcontracting of a country with a lower level of technology by one with a higher level of technology. For example, if Japan joins a new project initiated by the US, it only means that Japan has become a manufacturing subcontractor of the US project and is not leading the development of a core technology for its economy and industries.

In that case, do we need a strategy or blueprint with a long-run perspective for space technology development?



Overall view of large-scale model of Hayabusa

Kawaguchi: Yes. Politicians must think about a nation's grand design where national welfare is to be achieved in the long run, not the project cost to be shared by nations, which is a short-run issue.

On another international question concerning space development, since national borders are not fixed in space or in the ocean, any country may start in the future to develop space aggressively without concern for other nations' interests. Do you think we need international rules of space development in the future, now that Hayabusa has opened the age of exploratory space travel?

Kawaguchi: We have an international treaty on the utilization of space. However, it is not widely ratified among the nations of the world. It is natural that each nation has its own plan to take part in space development projects. Therefore, some countries may have a reason for not ratifying the treaty from their own future space development policy perspective. Perhaps, in the future, there will be a territorial question for the planet and also that question would be related to potential resources that a planet could preserve. Therefore, we should agree that any discovered planet must be a common asset for all humankind.

Nation's Industrial Policy & Education Could Change Future of Japanese Space Missions

Do you think a nation's industrial policy should lead space development?

Kawaguchi: Yes. I think governments should take the initiative in space development and expanding the space industry, since the investment risk is extremely high and the market size limited. If the

supporting industry for space development is extended in a diversified manner, its policy impact would be enormous.

Should Japanese education be changed as well in order to correct the defect of Japanese perfectionism you mentioned earlier?

Kawaguchi: Yes. We need an education system in Japan that encourages young people to find the positive aspects in everything, any plan or policy, instead of always trying to find errors or shortcomings. Discussing every possible shortcoming of a plan or policy does not lead to any productive solution.

Our Hayabusa project was successful because we made progress by adopting such positive thinking rather than negative thinking on the basis of perfectionism.

I believe individualism would encourage innovation. Bureaucratic management focusing on the equality of the members of an organization, which we often observe in Japanese management, is a hindrance to innovation, since innovation needs more intensive investment in a certain area that is envisaged by a long-term creative vision derived not from a bureaucratic management but from more individual or intuitive thinking. In the Hayabusa project, on the whole we encouraged each member's individual competence and creativity to be integrated into our challenge to face the unknown, though we are a very small group and so I am not quite sure if we can refer to it as a management success story.

The most difficult part of managing this project was to persuade each participating researcher to give up a certain portion of his or her own passion to achieve the dream, because of the constraints of resources and time, etc. We were always pursuing a better outcome of the research through the full exploitation of each researcher's passion and creativity under these constraints in Hayabusa.

Ambitions for Second Stage of Hayabusa

The second stage of Hayabusa will begin soon. What are your plans or ambitions for your challenge as it reaches its second stage?

Kawaguchi: We have already started the second stage of the Hayabusa project. This project aims at exploratory travel to another planet. I am no longer a key member but am participating in this project as an advisor. There are a number of reasons for my retreat from being a member of the project. In terms of formality, I will be retired by 2020 when this project will be concluded. But the need to raise my successors is a much more important reason. It is too late to start raising successors in the following generation after the



Special lecture at JAXA's Sagami-hara campus

people in the first generation have retired. We should have a mechanism for transmitting knowledge and skills from the first generation to the second through discussions between them. Unfortunately, since space development usually takes a long time, there are very few opportunities for many young researchers to participate in a long-run project from beginning to end during their lives. Therefore, we senior researchers should leave as many opportunities for the younger generation as possible. Otherwise, being given few chances, young experts would not be well-educated. Practical learning is more important than learning from a textbook. It will be very important for me in the second stage of Hayabusa how many learning opportunities I can leave for my younger colleagues.

On the other hand, what is important for young researchers in the second stage is that each of them should be as active as possible in thinking about new issues or the direction they wish to pursue on their own. This active rather than passive learning could be applied to any level of education.

Finally, Hayabusa has achieved a great reputation all over the world and its touching story has even been adapted into a film. This will perhaps encourage young people in Japan to become more interested in science and technology. Wouldn't this be wonderful news for scientists?

Kawaguchi: Yes, of course, we would welcome such a phenomenon. The number of research papers is certainly a kind of barometer of the development of science in a country. But, more importantly for scientists, such an outcome of scientific research should lead to industrial or economic prosperity. We would be very happy and honored to see such popularity of Hayabusa contribute to raising scientists in the next generation and thus to the significant progress of science and eventually an increase in national welfare. **JS**