# The Human Perspective

Designers challenge to be included in the reshaping of space design because they can provide a human touch to highly engineered spacecraft. Earth and Extraterrestrial architect Barbara Imhof outlines the contribution architects can make to life up there – with feedback from several astronauts.

Barbara Imhof



Last year in 2009, we celebrated the 40th anniversary of Apollo 11 when the first humans landed on the Moon. Next year in 2011, we will celebrate the 50th anniversary of the first human, Yuri Gagarin, to successfully orbit the Earth. When Yuri Gagarin entered his spacecraft, it was the seventh attempt to launch a human in the Vostok capsule. The head of the Russian space program, Sergej Korolyov, set April 12, 1961, to be the date for another 50% chance of a successful launch. Six rocket test-launches had been made previously, during which three of the rockets had blown up. Three official statements had been prepared for the event on April 12: one in case of success; one in case of rocket failure; and one in case the cosmonaut died somewhere between launch and landing. It had also been suggested that Gherman Titov, Gagarin's back-up, should be first choice as he had no children, unlike Gagarin who had two daughters. Yuri Gagarin had a ten-day ration of food in stock just in case he could not return after the first orbit. He was connected by a radio transmitter to Mission Control throughout his 108 minutes of flight, and also to a monitor to record his psychological stress levels since the risk of a psychological breakdown was high. A photograph taken in the bus on his way to the launch pad shows a pensive man who is trying to grasp the magnitude of the meaning and significance of things to come, and the chance that he is either on his way to his own death or to become a hero.

Detailed reports of most early human spaceflights read like thrillers. Although spaceflight today seems a day-to-day business, with people being launched into orbit on a regular basis, the risk of failure and human death remains very high.

When we set foot on the Moon again sometime beyond 2030, our resources will be limited. For this endeavor, we will have to develop closed-loop regenerative life-support systems to recycle air, water and waste, which will sustain us throughout a long duration stay on the Moon. In addition, we will need to look at the resources of the lunar environment in order to start living off the land. Caring about our resources and developing technologies for new ways of sustainable living beyond Earth will also lead us to a life that is capable of expanding into the future.

Although the Moon seems further away than ever due to current governmental space policies, it remains our closest celestial body, an object of fascination for every generation. The Moon also serves as an optimal test bed for missions to Mars, and it is an ideal location for a far-side telescope to look even deeper into the universe. There are plenty of new tasks waiting for intensive scientific investigation. Through renewed lunar exploration, it is very likely that we can increase our knowledge about the universe and ourselves.

In order to generate new interest, and again find sufficient financial support, new actors have to find their place in the space arena. A new understanding of space and what space exploration signifies to humankind has to be defined, including the education and inclusion of specialists: architects, designers, sociologists, anthropologists, cultural theorists and artists. In addition, people need to be included in the space programs who have the task of conjuring ideas to develop and promote the human perception of space and its exploration.

Architects and designers are concerned with the human perspective with every project they work on. What roles can they play in the next steps of human spaceflight and exploration?

There are two main areas of contribution.

Firstly, space is an extreme and unforgiving environment with great technological challenges. The main technical requirements are mostly delivered by space engineers and scientists; it is this scientific approach that is the prevailing paradigm. Architects need to contribute to changing this paradigm with their focus on the human system. It needs to be treated equally as important as technical systems. Architects and designers know how to join both the human and machine perspectives.

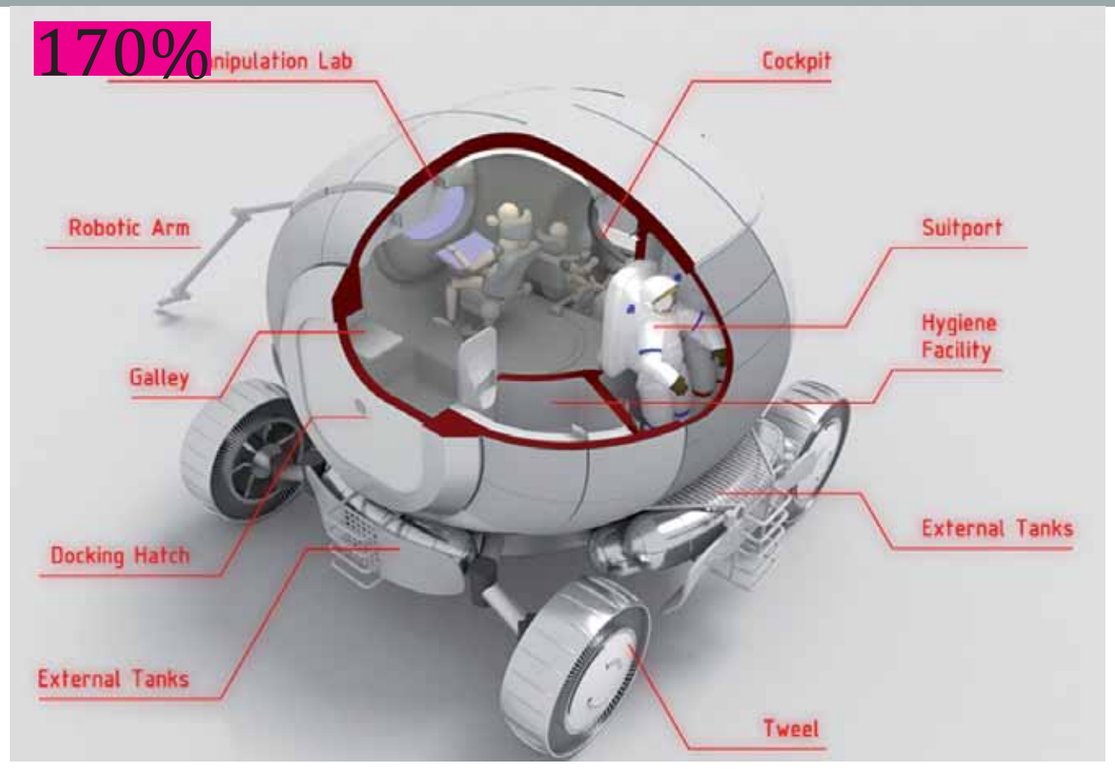
Long duration missions on the Moon or to Mars will require a different cultural approach in order not to jeopardize the mission. When a spaceship environment on a six-month trip to Mars creates psychological stressors for the crew, a well-functioning technical system will not solely solve the problem. Therefore in the long run, there is an urgent need to change the conditions of space travel by incorporating cultural aspects – for example, to make the living environment more home-like and comfortable – that will give the space traveller a sense of well-being. Investigation into these matters inevitably draws attention to the technologies needed, but moreover to the physiological and psychological strategies (with their spatial implications) required to cope with these extreme environments.

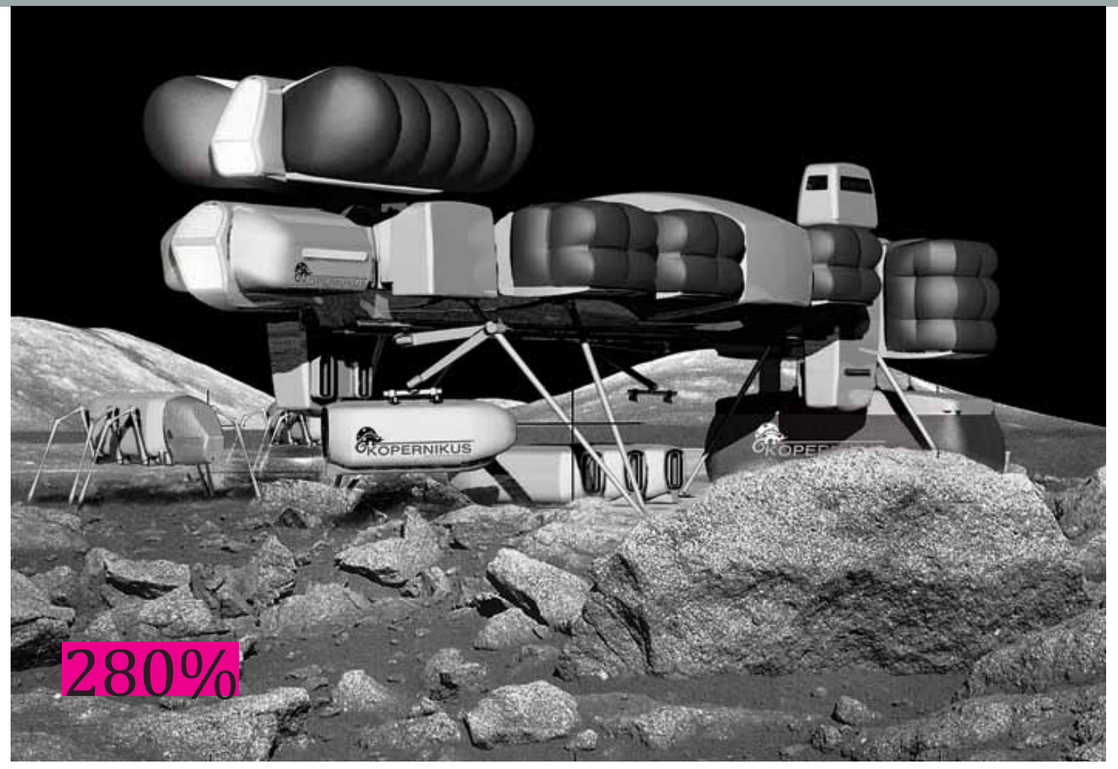
There are significant amounts of data on zero-gravity. Particularly, we can utilize information accumulated through the ISS for missions to the Moon and beyond. The answers of Sergej Krikalyov (male, Russian, engineer), Jean-François Clervoy (male, European of French origin, pilot), Chiaki Mukai (female, Japanese, medical doctor) and Claudie Haigneré (female, European of French origin, medical doctor) demonstrate the differences in professional background and culture – important aspects of international crews in all missions to come. Their perspectives constitute a multi-layered input for space designs.

What is some feed-back an astronaut can give on design issues, and what is the relationship of a good design with crew performance?

> 'There is a connection. On the Russian side, we used to have light on one side, basically light on the ceiling and paint of different colours on the floor except in one of the modules – we saw that in the early assembly of the space station – the Node module, lights shone from different sides and I found that difficult, especially for people who had less experience in space and in weightlessness. After they had worked in a specific area, they turned several times and then when they needed to go somewhere (because space up there is close to being symmetrical) they spent a few seconds to try to orientate themselves to be sure that they were going in the right direction. So I think a good design will help you to save this moment of disorientation.' (Krikalyov)[1]


146%




> ‘Yes, I think, we can improve the mental comfort by putting more energy, more effort into the design aspect, the cosmetic aspect of the vehicle. The Russians have already thought a bit about this by having different colours for different surfaces. So you always know the floor is one colour, the ceiling another, and the walls another. On short missions it’s not important, but for a trip to Mars, I think it would help to have a nice layout with some ‘paintings’, or a nice window design, so that you don’t have the feeling of being constantly in a technical environment, otherwise you would feel like you were sleeping, eating, or having a wash at your work place. It is not nice to feel that you live all your life at the office. It is nicer when you think that you have your office to do your work and sometimes you can go into a different kind of place to do something else. So I think, organizing the layout, the colour, the shape, with more design innovation would probably help.’ (Clervoy)[2]

The above statements sound supportive to the work of the designer. To tie good design to good performance is a very convincing argument, especially when one astronaut hour in orbit costs approximately US$ 200,000. But one can also interpret from the answers that there is no general understanding of architectural design. Therefore, we are still in a stage where we have to prove our capabilities to get full recognition.

The most intriguing environment to design for is weightlessness without up-down and left-right. Nothing is in a way architects are used to work with. There are no chairs, beds or tables. Every paradigm has to be defined anew: a paradise for architects. So how is the orientation in zero-gravity?

> ‘Gravity helps with your sense of orientation and this is missing in space. If you have no gravity, there is no up and down, no right and left. But thanks to gravity we share a common ground plane. So we are all standing on the same floor (plane). In space we have a truly three-dimensional area and somebody’s floor becomes somebody else’s ceiling. It makes people feel unstable, not only from a physiological, but also from a psychological point of view.’ (Mukai)[3]

> ‘In space even when you bend a little bit, you can change your body position easily. For some tasks it is important to use both hands, so you have to have your body steady, and for this you need handrails. You use your feet as hands and we have restraints on the walls, and on the floor to anchor ourselves. Sometimes, it might feel awkward; this is due to lack of experience. Basically, you just need to touch the restraints lightly and that is enough to stabilize you.’ (Krikalyov)[4]

> ‘You train on the ground but it does not help for space – you know the basics where the main things are but when you go up there and you open the hatch, it looks different; nothing is as it was in the trainers; it is all crowded, everything looks different and you have to learn everything again, where things are and how to position yourself in the space in relation to the other things. When you arrive in microgravity you do not have the same references anymore, it is not the same space anymore as it is when you train on the ground, it is crowded with stuff and it is totally different. And it is a totally different volume – it is huge and you realize that you live in a volume not in an area (plane).’ (Haigeneré)[5]

The imagination of being in such an environment, and sharing the experience that only astronauts have had before, leads to the second field of a designer can contribute to space architecture operation: space tourism. The ‘fun sector’ of space tourism could become the driving force for the next step in human spaceflight. Very likely this will propel the space industry and accelerate the advancement of safe technologies for human spaceflight. A hotel on the Moon built and financed by a hotel tycoon might become a substantial contribution to any further human exploration with new materials, new construction methods and new paradigms for life and leisure. Apart from space tourism’s economic benefit, it will have a social and cultural value where each of us could eventually become a space traveller.

Human spaceflight, regardless of governmental or commercial activities, will continue to generate technologies and knowledge for Earth. In the area of advanced life support systems, spin-offs such as water purification systems and waste management from space are already on their way to be implemented in buildings on our planet. In this way, it is a logic step that architects and designers get involved in the design of habitats in space, on Moon, Mars and beyond.

1 Barbara Imhof, ‘Long duration stays on space stations’ interview with the Russian cosmonaut Sergej Krikalyov, Radio Orange, August 19, 2008. He is record holder with six spaceflights and a total stay in space for 803 days. He has flown with Soyus on MIR and on the ISS and he has also flown with the space shuttle. He has excellent knowledge of the Russian and the American technical human space systems.

2 Barbara Imhof, Interview with astronaut Jean-François Clervoy, Radio Orange, October 12, 2008.

3 Barbara Imhof, Interview with JAXA astronaut Chiaki Mukai, International Astronautical Congress, Glasgow, UK, September 2008.

4 Barbara Imhof [note 1].

5 Barbara Imhof, ‚Spaceflight as a Social Phenomenon‘, Interview with former astronaut Claudie Haigneré , *The Mix*, Issue No.15 (May 2008) p.54f.