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ZERO-G-NAUT AND MISSION COMMANDER TO SUPPORT COMMERCIAL SPACE MISSIONS AND CUSTOMER ACTIVITIES INSIDE CABIN

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Abstract

When civilian spaceships begin to fly, the same needs as the zero gravity flight services will be created to cater different customer needs in space. The needs of space travelers are not limited to viewing Earth from space or to experience zero gravity, but to realize their individual requests such as wanting to have a wedding in space, film movies and commercials, etc. In order to tailor a personalized need, the mission support astronaut which we define as a “Mission Commander” will become an important role. This is not only an astronaut who controls the spaceship or experimental equipment, but also the same as our ASTRAX mission support zero gravity astronauts, who travel together with the customer(s) on the cabin side to understand their requests in the spacecraft. The trained support astronauts’ job is to make the customer’s dream come true in space. Pre-flight preparation and training are also required in the customer’s country, especially in cases where language, cultural and religious barriers can potentially impact the mission outcome. In this way, at ASTRAX, we provide total production service to our customers who have arranged a spaceflight contract through our company, starting with listening to their individual needs, selection of the appropriate spacecraft, space flight contracting, preparation, and training until rehearsal and the actual flight. As part of this cycle, we have the ASTRAX Mission Support Control Center to support missions (not only scientific experiments but including various needs) performed by passengers in the spacecraft cabin including the Mission Commander who flies into space with passengers to support and move behind the scenes. A spaceship simulator for training and rehearsals are also available. ASTRAX operates a commercial space flight support educational institution called ASTRAX ACADEMY in addition to such facilities. We provide training for Mission Commanders to support space missions (focusing on what ordinary customers want to do in space), education and training for both the space travelers (passengers) and operators who support the space travelers.

It is important to have astronauts and Zero-G-Nauts (zero gravity astronauts), who support the passengers, to perform missions on behalf of the passengers inside the cabin. Here, we introduce the roles of Zero-G-Nauts and mission support astronauts and the preparation and training systems needed for each mission.

Keywords: Zero-G-Naut, Commercial Astronaut, Mission Commander, Space Flight Attendant, Space Travel, New definition of astronaut

1. Introduction

ASTRAX has been providing zero gravity flight services in Japan and the United States since 2012. From our experience, we have come to the conclusion that the existence of Zero-G-Naut (Zero Gravity Mission Commander) is very important to acknowledge the dreams of our customers who are experiencing zero gravity.

We are convinced that the existence of a Mission Commander will be necessary in the coming era of space travel to fulfill the dreams of the space travelers. (Fig. 1) In this paper, we will define and summarize the cabin crew including the Mission Commander in zero gravity flight and space travel.



Fig.1 ASTRAX zero gravity flight services

2. Zero gravity astronaut

First, let us consider the definition of zero gravity astronauts.

2.1 Pilot and cabin crew

Let's think about the people who will be flying weightless and working on board a zero gravity flight in a zero gravity flight experience service for the general public, rather than a zero gravity flight service for scientific experiments.

First of all, current planes for zero gravity flights are not yet fully automated, so we would need pilots to fly the zero gravity planes. It could be said that they are one of the first zero gravity astronauts.

A cabin crew (including a photographer) will also be needed to board the cabin side of the plane and provide support to customers. Also, if there is a problem on the cabin side, the pilot (captain) needs to be contacted immediately (as the pilot cannot see the cabin side). In the interest of safety and smooth operation, zero gravity astronauts are inevitably needed on the cabin side as well. This is most likely the standard for any company's zero gravity flight service in any country.

However, in the case of ASTRAX, which provides zero-gravity flight services in Japan, there are two types of cabin crew members who provide support to customers in the cabin side. (Table 1) We will explain them in section 2.2.

Table 1 Zero-G Astronauts

Zero-G Astronauts	
Zero-G pilot	
Zero-G flight cabin crew	
	Zero-G flight attendant
	Zero-G-Naut (Zero-G Mission Commander)

2.2 Zero-G Flight Attendant and Zero-G-Naut

ASTRAX offers two types of cabin crew (roles) for its zero gravity flight services.

The first is the regular flight attendant, who assists the customer in a safe zero gravity flight experience and at the same time takes pictures with a camera. The services provided by these attendants will be equally available to all customers and will be included in all regular packages of the zero gravity flight services.

On the other hand, the role of another zero gravity cabin crew, which ASTRAX calls a Zero-G-Naut, is very different from the precedent Zero-G flight attendant. Their job is to work behind the scenes to support the customers in executing the dreams and missions they want to achieve in zero gravity. Because the customer is the one who executes the mission, those who are similar to a mission specialist in space, is the customer. Making the role of supporting the customer's mission, the Zero-G-Naut (Zero-G Mission Commander). The Zero-G-Naut's role is different per flight because they will be required to manage and control all of the missions for each customer.

So what are the customer needs in the zero gravity flight experience? I will summarize the customer needs of the zero gravity flight services that ASTRAX has provided in Japan in sections 3.



Fig. 2 ASTRAX Zero-G-Naut supporting client missions in flight

3. Various missions (needs) of zero gravity flight in Japan

3.1 Overview of Zero Gravity Flight Service in Japan

ASTRAX's zero gravity flight service in Japan has been using a small jet, the Gulfstream 2 (which will be replaced by the MU-300 aircraft). Customers can fly with six people on board (two pilots, two airplane company's flight attendants, one ASTRAX Zero-G-Naut, and six customers), with a total of 11 people.

There are only six customers per zero gravity flight experience, so each person can do a different simple experiment or challenge. For example, there were people who flew for weddings and proposals, played musical instruments, shot corporate PR footage, flew in costume, and even flew as a wizard on a broomstick. In order to meet these needs, along with advance preparation,

coordination, and cooperation among customers, it is essential to have a Zero-G-Naut on board to support each mission. This support and direction increases the success rate of the customer's mission.

3.2 The ASTRAX service for every flight

First of all, the services, preparatory work, and technology that ASTRAX provides to its customers for each of its zero gravity flight services include the following. (Table 2)

Table. 2 ASTRAX Service for Zero Gravity Flight

Category	Contents
Preparation	attracting customers, communications, logos, merchandise, letters, guidelines, customer information management, ordering, various arrangements, medical examinations, health care, document management, team building, etc.
Pre-flight services	hearings, transportation support, mental checks, mental support, etc.
In-flight services	mental support, filming support, experimental support, action support, real-time coordination and negotiations during the flight, etc.
Post-flight services	(transportation support, luxury parties, special certificates and award ceremonies, accommodation support, etc.)
Confirmation of post-flight impact	(evaluation of impact after return to normal life)

Section 3.3 describes the different missions of each individual passenger (or flight).

3.3 Various missions and passengers' requests that have been carried out

The common services (other than the zero gravity experience) that are performed throughout each flight include photo opportunities, lunar gravity and Martian gravity experiences (although whether or not Moon gravity or Mars gravity is performed depends on the customers' request and whether or not the customers are fatigued or has a time constraint on the flight time). The following are some of the various experiments and missions that have been performed in zero gravity by customers who have participated in the ASTRAX zero gravity flight service.

Table 3 The Experiments and Missions in the ASTRAX Zero Gravity Flights

Category	Contents
(1) Equipment, instrumentation, and functional tests (to determine if the aircraft can be used and performed in zero gravity)	
	Blood Pressure Measurement
	Lotion application experiment
	Accessory (bracelet) behavior test
	Accessory (necklace) behavior test
	Small Medical Device Communication Experiment
	CASIO watch experiment
	CASIO Digital Camera Experiment
	SEIKO Watch Experiment
	Smartphone normal shooting experiment
	Smartphone levitation photography experiment
	New zero gravity flight suit demonstration
	Arm wrestling experiment
	Demonstration test of equipment 1 for taking group photos
	Mixing experiment (two liquids)
	Demonstration test of equipment 2 for taking group photos
	New Space Flight Suit Demonstration Experiment
	Soap bubble coloring experiment
	Propeller model airplane flight experiment
	Bamboo-copter flight experiments (Part 1)
	Fan flying experiments (three types)
	Demonstration test of equipment 3 for taking group photos (Part 1)
	Demonstration test of equipment 3 for taking group photos (Part 2)
	Model airplane flight experiment
	Flight Experiments of Bamboo Dragonfly (Part 1)
	The Can of Candy Experiment
	Space food docking experiment
	Water balloon + carbonated water + sponge experiment
	Cocktail Glass Experiment
	Verification of the importance of the pre-briefing
	Corset wearing experiment
	Experiment in wearing an eye mask
	Cash floatation test
	Smartphone levitation photography experiment (Part 2)
	Illustrative Drawing Experiment
	Boomerang test
	Water and oil mixing experiment
	Water and foam mixing experiment
	Blood Pressure Measurement experiment
	Electrocardiogram Measurement Experiment

The Wrinkle Experiment
Neck corset wearing experiment
The Wiggle-Off Experiment (Part 1)
The Wiggle-Off Experiment (Part 2)
Microgravity Scooter Flight Experiments (Part 1)
Hand-spinner flight test
Microgravity Scooter Flight Experiments (Part 2)
Terminal Connection Experiment
Underwater drone flight experiments (report writing)
Underwater drone operability verification test
Flower arrangement experiment
(2) Action & sports (Can it be done in zero gravity?)
Rotational flight experiment
Superman-like flight experiments
Water-drinking experiment
Space Curry Tasting Experiment
Experiments in flight with the Wizard's Broomstick (Part 1)
Microgravity Human Tennis Experiment
Flight experiment with balloons
Flight experiment with a handy fan
Flying Carpet Experiment
Experiments in flight with the Wizard's Broomstick (Part 2)
Ping-pong experiment (Part 1)
Iron Array Experiment
Harry Potter's Broomstick Flight Experiment
Experiment with drinking tea from a shampoo bottle
Ping-pong tournament
Experiment to get out of a flight suit (scene from Lupin III)
Jump rope experiment
Macbook (3 units) programming experiment
Ping-pong experiment (Part 2)
Normal levitation experiment
Experiment of eating a rice bowl (onigiri) in a ceramic bowl
Paper Plane Boarding Experiment
Origami crane boarding experiment
Braveboard flight experiment
Superman Flight Experiment
Candy making experiment
Vinyl airplane flight experiment
Space cleaning experiment with a handheld vacuum cleaner (video shoot for corporate PR)
Window cleaning experiment (video shoot for corporate PR)
Zero-G magic experiment
Ballroom dancing experiment
Sash-turning experiment

Backflip experiment
Hula-hoop diving experiment
Cocktail Glass Experiment
Writing experiment in zero gravity
Skateboarding experiments
Swimming experiment
Flying wiggle experiment
Curry eating demonstration
Gravity of Mars to Gravity of the Moon to Zero gravity stepwise flight experiment
Forward somersault experiment
Water drinking experiment
Boxing experiment
Shoe-shine experiment
(3) Cosplay levitation experiment
AKB48
Angel
Ornaments (hat, sunglasses)
Witch's delivery service
Dragon Ball
Harry Potter (Fig. 3)

Fig. 3 A passenger put on a costume of the Harry Potter in zero gravity flight
Camouflage clothes
Prince Rocket's Cloak
Swimsuit
Hanshin Tigers Cheering Happi
Superman
Cloak (Part 1)
Hatsune-Miku
Prince Curry-Roux
Cup ramen man
Santa Claus
Nobi Nobita (Doraemon)
Sadako (the Ring)
FP Ranger
Doctor's lab coat
Spider-Man
Cloak (Part 2)

Mo-yan curry costumes
(4) Costume levitation experiment
Men's business suit
New zero gravity flight suit
Kimono (Yukata)
New zero gravity flight suit (Gekidan Space Shokudo stage costume)
Kimono
Loincloth swimsuit
Original flight suit
(5) Object PV shooting experiment
Mineral water
Books (Part 1)
Leaflets
Books (Part 2)
Imitated Gold bar
Bill
Books (Part 3)
Passport
Candy (Part 1)
Books (Part 4)
Corset
Underpants
Towelket
Organic millet rice
Shumai bento (boxed meal)
Sesamin
Books
Candy (Part 2)
Stuffed dog
(6) Video shoot for corporate & personal PR
Macbook Programming Experiment (IT Company)
Space cleaning experiment with a vacuum cleaner (building maintenance company)
Experiment with window cleaning in zero gravity (building maintenance company)
The world's first zero gravity magic shoot (magician)
Kimono and Fundoshi semi-nude shoot experiment (model)
Aliveen PR shoot (health promotion product company)
Saida Dermatology PR shooting (for hospital PR)
Space traveler PR shooting (for Space Working-Mom PR)
Photo shooting for PR of Mo-yan Curry (ukulele, singing and eating curry)
PR photo of Tamura Construction (with uniform & flag)
Shooting for music video
(7) Photography experiment
CASIO Digital Camera Experiment

Smart Phone Microgravity Normal Photography Experiment
Smartphone Zero Gravity Levitation Experiment (Part 1)
Head-mounted camera experiments (Part 1)
Head-mounted camera experiments (Part 2)
360-degree camera shooting experiment
Single-lens reflex camera experiment (Nikon)
Smartphone Zero Gravity Levitation Experiment (Part 2)
3D camera photography experiments (Part 1)
3D camera photography experiments (Part 2)
(8) Various missions
World's First Zero-Gravity Marriage Proposal
Flight verification of artificial legs (Part 1)
Record-breaking for the youngest (11 years old) person
Family Ties Demonstration Experiment
The youngest ever recorded (10 years old) person
Demonstration experiment against social withdrawal
2day series flights demonstrations (Part 1)
Employee-to-employee flight verification (president and general manager)
Zero gravity flight in USA, Verification of Japanese customer service (transportation from Japan, accommodation, interpretation, etc.)
Verification of handling large numbers of customers (different from small group flights in Japan)
Verification of artificial legs (Part 2)
2day series flights demonstrations (Part 2)
Husband and wife flight verification (Part 1)
Husband and wife flight verification (Part 2)
Employee-to-employee flight verification (president and employees)
Parent-child flight verification (mother and daughter)
Family Flight Demonstration (father, mother and daughter)
Couple Flight Demonstration
Civilian Astronaut Training
Space travel training (Part 1)
Zero gravity flight attendant experience training (Part 1)
Zero gravity flight attendant experience training (Part 2)
Space travel training (Part 2)
Space travel training (Part 3)
Space travel Training (Part 4)
Space travel Training (Part 5)
Zero gravity flight attendant training
Space travel Training (Part 6)

3.4 Working to support the needs of customers

ASTRAX has recognized various customer needs as shown in section 3.3. Zero-G-Naut has been able to meet the needs of many customers in zero gravity flight.

Zero-G-Naut's role is to make our customers' dreams of zero gravity flight come true. To do this, we interview, coordinate, negotiate, prepare, rehearse (if necessary), and support them during the actual zero gravity flight. If necessary, we will follow up with them afterwards. If they have a request in a zero gravity flight, they can't do it by themselves. It's important to have supporters who can make it happen with them. A hundred customers have hundreds of different needs, reasons, and stories. It's our role at ASTRAX, and our job at ASTRAX Zero-G-Naut, to meet each and every one of those needs. And the number of needs we fulfill highly depends on the technology and experience of the Zero-G-Naut.

4. Astronauts

Until now, the only people who have visited to space have been astronauts affiliated with the government (who make space flights on the government's budget), pilots of commercial spacecraft development companies, and space tourists (general tourists who have gone to the International Space Station, etc.). However, more and more people will be going to space in various capacities. In this section, we will examine several categories, focusing on crew members who board the cabin side of commercial spacecraft, and briefly touching on other astronauts).

4.1 Government astronauts

Government astronauts include the American Astronaut, the Russian Cosmonaut, and the Chinese Tikonauts, while each country has a different definition of government astronauts. Since this paper discusses astronauts on a commercial spacecraft, a detailed description of government astronauts is omitted here. What all of them have in common is that they are funded by the state to go and work in space.

4.2 Are space travelers astronauts?

In ASTRAX, a person who goes into space for his or her own leisure is called a space tourist. A person who goes into space on a mission or to support someone else is called a civilian spaceflight. A person who travels to space for work is defined as a space business tripper. Thus, even if a spacecraft operator treats you as a space traveler, the term traveler may not fit with what you do

on that flight. In the future, we will need to unify the names internationally to avoid confusion.

4.3 Commercial astronauts

In contrast to government astronauts, we could call all those who went into space with private capital, commercial astronauts.

It is very straightforward to refer to the pilots of the spacecraft operators as commercial astronauts among those who go into space with private capital. But astronauts who fly on the cabin side (astronauts who do not fly spacecraft); such as NASA's mission specialists and payload specialists in the space shuttle, would also be called astronauts. A distinction between them and pilots would be required.

So what about the cabin crew of the commercial spacecraft? As mentioned before, they are astronauts who fly in space with space travelers and provide support to their customers. In our opinion, similarly to the zero gravity astronauts described in section 2, we will need astronauts who provide certain services and astronauts who can handle multiple tasks (or have special skills). We would refer to them respectively as Space Flight Attendant and Mission Commander. (Table 4)

Table. 4 Type of commercial astronauts

Commercial astronaut	
Pilot for commercial spacecraft	
Mission Specialist for commercial spacecraft	
Payload Specialist for commercial spacecraft	
Cabin crew for commercial spacecraft (with customer on board)	
	Space flight attendants
	Mission Commander (Multi tasks attendant in space)

4.4 Types and definitions of space travelers are difficult to define.

There are several (or infinite) types of customers who pay to board a flight. As with terrestrial travel, those who use their personal money to go into space for personal leisure could simply be considered space travelers.

But when you think about it, it's very difficult to distinguish between the two. A spacecraft operator or space travel agent might think of the passengers as a space traveler. However, if the passengers are going to space with their own company's business or mission, they will think of it as not being a trip (i.e., a space business tripper would be more applicable). For example, whether

you call someone who boards a SpaceX spacecraft to go to the International Space Station an astronaut or a space traveler depends on their title, and from SpaceX's perspective, they are still a customer. But if you call someone on a SpaceX spacecraft an astronaut, then a space passenger is also an astronaut.

Depending on your title and the type of work you do, you may be a space traveler, but your original title may be a photographer or a singer. Once working in space becomes your day job, space worker is a better fit than space traveler, and it's better to call it by a professional title, such as space photographer or space singer.

To further complicate things, it could be a case of combining work and leisure. Given this, saying "space traveler" alone is too broad, and we will need to subdivide the name into various subcategories, depending on the title and the nature of the mission (e.g., space photographer or space singer). Some people will be going to space instead of traveling, and some will be complex people who have several roles at the same time. Furthermore, it is conceivable that the division between Earth and space will eventually cease to be necessary, even though that is how we say "space XXXX" now.

4.5 People working on the cabin side of the spacecraft

ASTRAX considers non-pilots on board the spacecraft, including those who do not belong to the spacecraft operator but accompany the customer (from the spacecraft side, they are one of the customers), by dividing them into several categories as shown in Table 5.

Table. 5 People Working on the Cabin Side of the Spacecraft

People Working on the Cabin Side of the Spacecraft	
Astronauts who belong to a spacecraft operator	
	Pilot
From the perspective of a spacecraft operator, as the customer (cabin crew)	
	Space flight attendants
	Mission Commander

5. Mission commander and space flight attendant

5.1 Mission Commander

In space flight, ASTRAX calls the person who goes to space for work and further supports the customer's mission, a mission commander (in zero gravity flight,

they are called Zero-G-Naut). In this case, the subject of conducting the mission is the customer; making the customer the mission specialist. The mission commander is the behind-the-scenes astronaut who provides all kinds of support for the customer's mission. However, many of our customers are new to space flight, so it is actually the experienced backstage astronauts who give instructions and make decisions. For this reason, we call them mission commanders because they direct and supervise the missions of all the astronauts, instead of playing the role of a mission specialist who proactively conducts missions in space.

There are some missions that cannot be accomplished by just one mission commander and the customer. In that case, there may be more than one mission commander on board. In addition, some missions may be accomplished with the cooperation of ground-based mission support and control centers (please see a separate paper on ground operations support and control centers for space travel missions).

In the future, space travel customers will demand a variety of needs and missions, just like our zero gravity flight customers. It is the role of the mission commander to make it happen. (Fig. 4)



Fig. 4 ASTRAX Mission Commander

5.2 Space Flight Attendants

On the other hand, there is also the position of a Space Flight Attendant. That is not the same as a mission commander. In some ways, you could say it's part of the mission commander.

The number one role of a space flight attendant is to provide hospitality to travelers who are going to space for leisure. In other words, it's the space version of an airplane flight attendant. Unlike a mission commander who supports each customer's individual mission, a space flight attendant helps customers enjoy space travel in a safe and comfortable manner. In addition to hospitality,

the role requires skills such as emergency response, emergency lifesaving, camera work, family support, and team building. (Fig. 5, 6) In addition, ASTRAX's group company ASTRAX IMAGINE defines, develops, trains and provides services. For more information, please refer to the ASTRAX IMAGINE's manuscript. [18]



Fig. 5 Space Flight Attendant (ASTRAX IMAGINE)



Fig. 6 SFA is taking photos in flight (in a simulator)

5.3 The problem of naming and definition

For some time after commercial space travel begins, the mission commander and the space flight attendant will be both zero gravity astronauts, since they will likely also be flying zero gravity with their customers.

Although they are now being named separately, in the future we will need to name zero gravity and space flights according to a unified rule to avoid confusion.

Also, as the market expands, various types of astronauts will appear, regardless of whether they are in zero gravity or spaceflight, and new names and definitions will be

given to them each time they appear. In the future, the number of users of space will expand all over the world and we will have to define names internationally. We will need to create a space version of an international standard by the International Organization for Standardization on Civil Space Development or others.

6. Conclusion

As the age of space travel begins, customers are going to demand all kinds of requests, as long as there are no safety issues. This is because you can almost do anything you want for money. For example, people might take their pets into space, or their kids might want to experiment with insects in space as homework for a science project. Unlike flying in an airplane, it's a completely different gravitational environment than on Earth, so it could be a tremendous evolutionary change for life on Earth.

In order to meet these unprecedented demands, it will be the cabin crew, not the pilot, who will be more important. (We believe that commercial spacecraft will be increasingly automated, and will be able to fly without a pilot.)

If a customer has flown in space many times, they may be able to do everything on their own, but it will take a while for that to happen. Until then, we will always need a mission commander (guide).

ASTRAX has dedicated training facilities, educational systems and tools to train people in all positions (photographers, chefs, singers, scientists, etc.) who can work in space. The accompanying mission commander will be part of that system and service.

These mission commanders and space flight attendants will never go away because human activity will continue to expand in the future. This is because as the human activity area expands, there will always be a need for a support guide (or like a mountain-climbing guide or Sherpa). The more experienced they are, the higher level of service they can provide to their clients' needs and the higher the success rate.

As the era of space travel begins and the roles in space become more and more fragmented in the future, the roles and names defined here will change again, but first, I have summarized the roles of zero gravity astronauts and commercial astronauts this time. I will continue to revise this paper as we keep an eye on global trends. I hope that this paper will lead to the development of the commercial space tourism industry in the future.

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