THE BIG LEAP

It's been 40 years since Apollo 11 landed on the moon - a milestone in mankind's history. But despite technical innovation and scientific breakthrough, the courage and commitment of those involved was probably the key to its success. Scott Snowden explains.
Images: courtesy Nasa and the Kennedy Space Center

History has demonstrated that the space race was the first endeavour of man - other than war - to challenge our entire scope of scientific and technological capabilities. The crowning moment in this challenge was when Apollo 11 travelled 260,000 miles in space, landed two astronauts on the moon and returned safely — a momentous event that took place 40 years ago on July 24 1969.

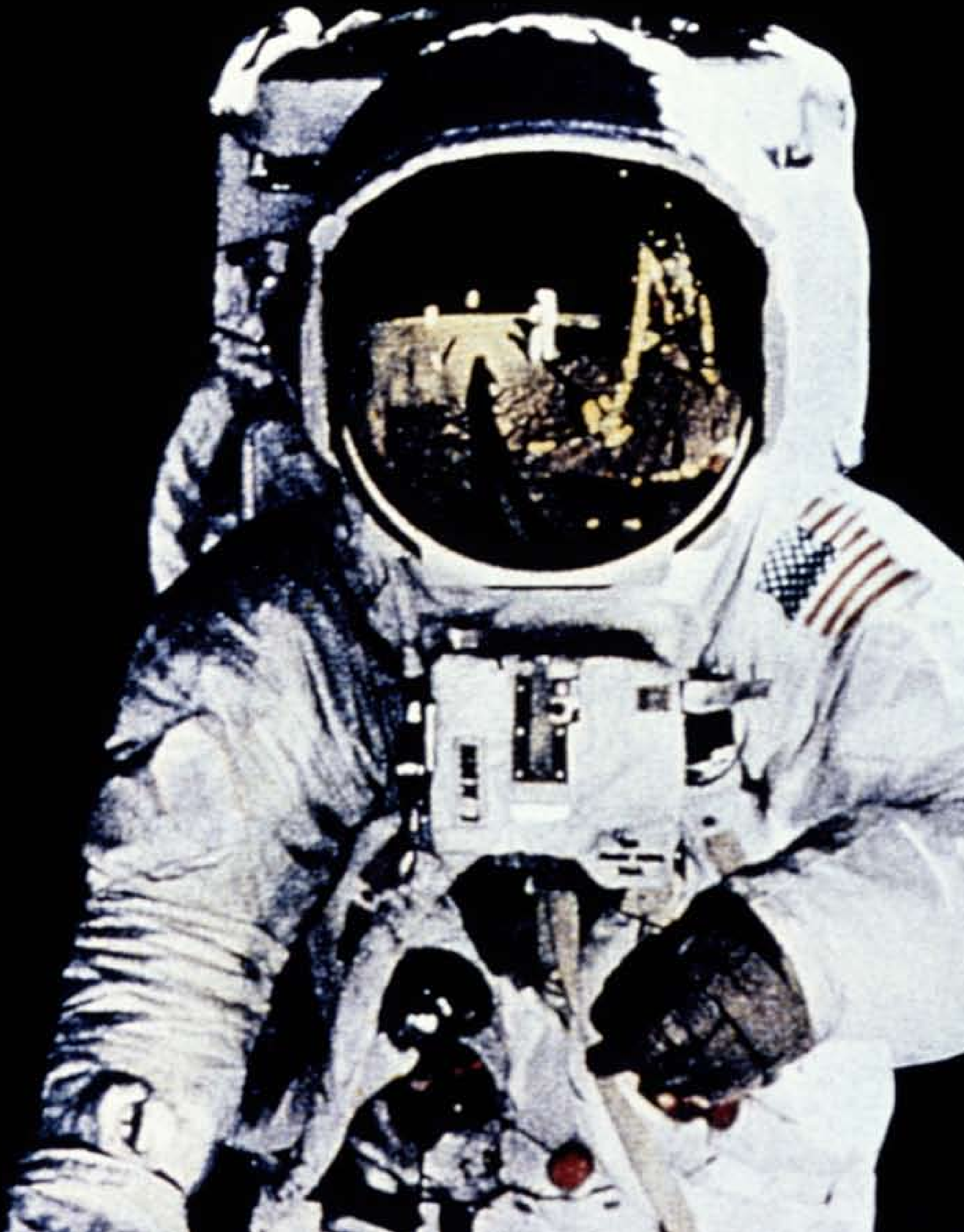
However, the full scope of scientific and technological capabilities at that time was not as advanced as many might think. It's not until a few facts are revealed that it becomes clear quite how many seemingly impossible problems were overcome with little more than daring and determination.

TO THE MOON ON THE POWER OF A LAPTOP

Jack Garman, an Apollo 11 computer engineer recalls that despite filling a whole room of the building, the total processing power of the computers in Mission Control was minute and had no more power than one of today's laptops.

However, running a space mission on the capacity of a single, modern laptop was a luxury compared to the computer power on the spacecraft itself. That was comparable to something between a digital watch and an early mobile phone.

As Apollo flew to the moon, hundreds of communications bounced between the spaceship and Ground Control and failing to comprehend just one message could



Text: Scott Snowden, freelance writer; Images: NASA , Kennedy Space Centre


The Apollo 11 crew board the astrovan


Neil Armstrong in the lunar module


The Saturn V blasts off


The Apollo 11 Crew, Armstrong, Collins and Aldrin

spell disaster. This placed everyone, from the most junior team member to the Flight Director himself, under immense stress.

As the craft reached lunar orbit, the astronauts prepared for what would be the most dangerous and unpredictable part of the mission - the descent to the moon itself. But as soon as the spacecraft came around from behind the dark side of the moon, Mission Control received tracking data that indicated it was not on the proper trajectory.

Guidance Controller, Steve Bells, called out, "Flight, I'm about halfway to my abort limit here - we seem to be out on our radial velocity."

As soon as he said the words "halfway to my abort limit", all contact was broken with the Lunar Module. Mission Control couldn't communicate with the astronauts.

IMPROVISING ON THE GO

Without communications or computer data, Mission Control couldn't monitor the module's systems or control its descent. Desperately, they tried another way. They re-routed a link to the Lunar Module via Mike Collins in the orbiting command ship. This patched-up improvisation restored a weak signal between the crew and the ground - but it wasn't to last.

> [...Mission Control received tracking data that indicated it was not on the proper trajectory]

It was up to one man, Flight Director Gene Kranz, to decide if Mission Control had enough information to make the 'Go/No go' decision and continue the descent to the moon. Five minutes prior to powered descent, he had his controllers go through a 'Go/No go' and immediately he lost data again. So he added the words, "Give me your Go/No go based on the last valid frame of data that you saw."

Flight Director (Kranz): "OK, all flight controllers, Go/No go for landing."
Retro [Retrofire]: "Go."
Fido [Flight Dynamics]: "Go."
Guidance [Navigation]: "Go."
Control [Control for the LM]:"Go."
INCO [Integrated Communications]: "Go."
GNC [Guidance, Navigation, Control]:"Go."
EECOM [Emergency, Environmental Consumables Management]: "Go."
Surgeon [medical]: "Go."
CAPCOM [Capsule Communicator]: "We're go for landing."

As communications cut in and out, the Lunar Module began to power its way down to the surface.

This descent was more like a controlled fall out of orbit, comparable to a car on a very long mountain road with the driver riding the brake to adjust the speed and keep from going too fast.

To avoid colliding with the moon, the Lunar Module now switched on its landing radar to determine its precise altitude. However, switching on the landing radar started a near-catastrophic chain of events that would turn the landing into a nail-biting drama.

SYSTEM OVERLOAD

An alarm sounded in the lunar module. Armstrong called out, "It's a 1202…" Mission Control responded, "Standby…1202."

No one knew what the alarm meant. Overwhelmed by information from the landing radar, the tiny on-board computer had crashed. Instead of giving the crew vital information, it was flashing up a major overload warning. On board the lunar module, the astronauts were aghast.

Jack Garman, however, had come across this alarm in a training exercise and had scribbled down the correct course of action on a scrap of paper. He advised that if the alarm was a one-off, the mission could continue. But the problem didn't want to go away. The landing radar continued to overload the computer.

Mission Control, "We've got another 1202 alarm."

With the computer plunging the lunar module into chaos, Armstrong decided to override it and take manual control of the vehicle. But by now, the spacecraft had veered a long way off course.

Aldrin and Armstrong were now flying over landmarks they didn't recognise - the Lunar Module was lost. That wasn't all; the descent engine's fuel tank was running critically low. With the Module still at 500ft, it was rushing into unknown terrain.

Neither the astronauts nor the mission controllers had ever expected or rehearsed such a white-knuckle scenario. They started a clock running to count down how much fuel was left.

Kranz instructed his controllers, "OK, the only call-outs from now on will be fuel…"

Armstrong knew the fuel supply was dwindling; he had to find a safe spot to land on. Looking out of the window, he saw a large crater littered with boulders the size of small cars, which is where the computer was taking him. With the fuel rapidly running out, the astronauts were faced with a serious problem.

JUST KEEP GOING

Normally, the easiest option is to slow the rate of descent and simply fly over any potential obstacles, but this would take more time and burn more fuel, reducing the remaining fuel required for takeoff.

MISSION CONTROL: "60 SECONDS."

Any who have seen and heard the NASA

Mission Control at Houston

Apollo 11 astronauts with Saturn V

footage replayed on television assume with little or no thought, that this is simply a call from Mission Control indicating how much time is left before the Eagle touches down. This was not the case.

Co-pilot Buzz Aldrin had to be careful not to disturb Neil Armstrong's concentration, but at the same time he was anxious to get the lunar module on the ground as soon as they could.

Their spacecraft continued to skim over the dusty, grey lunar surface.

The call goes out, "30 seconds."

Anyone at Mission Control not already on his or her feet now stood up as the tension continued to rise.

When simulating all possible outcomes while attempting to land, NASA had concluded that if it ever came down to 30 seconds, they would scrap it and abort the mission. But Neil Armstrong could see the surface of the moon through his small window and he knew that if he just kept going a little longer he would land the Lunar Module safely.

Through the windows of the Lunar Module, Aldrin could see the shadow of the spacecraft getting bigger and bigger and dust began picking up around them. Over the radio he informed mission control, "Contact light. OK, engine stop..."

Armstrong confirmed they had indeed finally touched down, "Houston, Tranquility base here, the Eagle has landed."

Houston heaved a collective sigh of relief and responded, "Roger that Tranquility, we copy, you're on the ground. We got a bunch of guys here about to turn blue. We're breathing again. Thanks a lot."

And as everyone at Mission Control caught their breath, they looked at their stopwatches... Apollo 11 had landed with 15 seconds of fuel to spare. ♂

10 NASA- INSPIRED TECHNOLOGIES

An unbelievable amount of today's technology that you take for granted has been developed as a result of the space programme.

1 Black & Decker created a rotary hammer drill that Apollo astronauts used to extract rock samples from the moon's surface. The company used that same technology to develop the Dustbuster and lightweight battery-powered medical instruments.

2 The thermal protection system NASA uses for re-entry to the earth's atmosphere is now used by NASCAR to protect drivers from extreme heat generated by the engines.

3 Although NASA did not invent the pizza oven, it made it more efficient by creating an air circulation technology that moves hot air around food instead of simply heating the oven cavity. When foods are heated this way directly, they cook four times faster than in conventional ovens.

4 A metal designed for use on the International Space Station is used in a Jack Nicklaus range of golf clubs. The metal, Nitinol, was developed by the Memry Corp and keeps a ball on the clubface longer - this gives it more spin, enabling it to cover greater distances.

5 NASA teamed up with Honeywell in the 1970s to invent the first adjustable smoke detector with different sensitivity levels that prevents false alarms. It was used at Skylab, the first U.S. space station.

6 NASA's moon boot technology is now used in athletic shoes. Sports equipment maker AVIA uses the same methods in NASA's space suit design in its shoe manufacturing.

7 Doctors, nurses and even parents can thank NASA for making oral and rectal thermometers obsolete. The ear thermometer - which can take a temperature reading in less than two seconds, is based on infrared technology NASA used to measure the temperature of stars.

8 NASA developed a translucent polycrystalline alumina to protect the infrared antennae of heat-seeking trackers. This was adapted by Unitek and is used for invisible orthodontic braces.

9 Scientists from Martin Marietta Materials evaluating algae as a food supply, oxygen source and recycling agent for long-duration space travel created Formulaid, which is now used in many baby foods.

10 Estée Lauder uses lunar research technology to evaluate skin care products. Digital image processing helps determine a product's effectiveness.