



## Mars Mission / Mangalyaan / MOM Spacecraft

### Introduction

The **Mars Orbiter Mission (MOM)**, also called **Mangalyaan** is a spacecraft orbiting Mars since 24 September 2014. It was launched on November 5, 2013 by the Indian Space Research Organisation (ISRO). It is India's first interplanetary mission and ISRO has become the fourth space agency to reach Mars, after the Soviet space program, NASA, and the European Space Agency. It is the first Asian nation to reach Mars orbit, and the first nation to do so on its first attempt.

### Why world and India is so much interested towards exploration on Mars / Why India and world choose MARS for explorations?

- Mars exploration will **help to address fundamental questions** about our place in the Universe and the history of our solar system. That means Mars goes through seasons, just like Earth.
- Mars has a **24-hour day**. The **rotational period** and **seasonal cycles** of Mars are likewise similar to those of Earth, as is the **tilt** that produces the seasons.
- Mars is a terrestrial planet with a thin atmosphere, having **surface features reminiscent** both of the impact craters of the Moon and the **volcanoes, valleys, deserts, and polar ice caps of Earth**.
- The explorations will help decipher **why and how Mars lost its liquid water**. This is important question essential for the long-term survival of human beings on Earth.
- This may give us clues to the presence of microbial life on Mars.
- Also, from a runaway greenhouse effect, **Venus is 900 degrees Fahrenheit** and would melt or vaporize most things you sent to its surface. **Mercury is also very hot**, being close to the Sun. So when you look at the nearby terrestrial planets, Mars is looking just right, in spite of the challenges.
- **Findings of Curiosity**
  - The red planet once had thick mudstones deposited in large lakes.
  - Red color of Mars is the result of iron reacting with oxygen—is only very few meters deep. Under this thin layer of red is a very different planet. These interesting findings generated new interest of knowing about Mars more.

### What it is? Features of Mangalyaan

- The Mangalyaan or **Mars Orbiter Mission** was launched on November 5, 2013 by the ISRO and it reached MARS on 24 September 2014.
- It is launched by using a Polar Satellite Launch Vehicle (PSLV) rocket C25.
- It costs 450 crore, weight 1350 kg, travelled for 300 days covered 65 crore km means 7Rs/km

- It Carries 5 instruments for **Atmospheric studies** (Lyman-Alpha Photometer (LAP), Methane Sensor for Mars (MSM)), **Particle environment studies**(Mars Exospheric Neutral Composition Analyser (MENCA)), **Surface imaging studies** (Thermal Infrared Imaging Spectrometer (TIS), Mars Colour Camera (MCC))
- It is India's first interplanetary mission and ISRO has become the fourth space agency to reach Mars, after the Soviet space program, NASA, and the European Space Agency

### Challenges faced during MARS Mission

- That includes propelling the spacecraft with **sufficient velocity** to escape Earth's gravitational grasp, **guiding** it along the **proper trajectory over vast distances**, and then **slowing it down sufficiently to go into orbit** around that planet.
- Since 1960, there have been **51 global missions to Mars** and the overall success rate stands at 42% which shows that it is quite difficult mission.
- The spacecraft had to be capable of operating autonomously as communication signals to and from ground stations could take minutes to reach it.

### Significance/Why it is a big achievement for India/ How it will benefit India?

- The mission is a **technology demonstrator** project to develop the technologies for design, planning, management, and operations of an interplanetary mission.
- ISRO's Mars Orbiter Mission team has won the prestigious 2015 Space Pioneer Award in the science and engineering category in recognition of achieving the rare feat in its very first attempt.
- **Cost effectiveness:** It is the most **cost-effective** interplanetary mission (only 450 crore) NASA spent 4000 crore of rupees on MAVEN.
- **Technological benefits:** The technology used in this mission has potential application in **weather forecast, computer tech, health-medicine** etc. in future
- Space research is not waste of time and money. (For eg.1999 Odisha cyclone killed >10000 people. But 2013 cyclone Phailin killed very few, because Indian satellite gave accurate weather prediction about where and when the storm would hit. Space research has given immense benefits to Agriculture, education, fisheries and defence)
- **Success in first attempt: No country** has ever reached Mars on its **first attempt** and too in such a **short time** (only 2 years). A successful mission will be a source for **national pride** and would force the world to take note of our technological prowess.
- **First Asian Nation:** India has created global history by becoming the first Asian nation to reach the Mars orbit in a space mission. The former Soviet Union and the U.S, who began their Mars pursuits in the 1960s, as well as Japan and China, failed in their first attempt to put their spacecraft into Martian orbit.
- **Economic Benefits:** As ISRO establishes reputation, gets more contracts from foreign countries and more foreign exchange.
- **Effects on foreign policy:** It can be used as a tool to exercise soft power by sending space missions of third world countries and SAARC countries.
- **Proved the capability and efficiency of ISRO:** After successful competition of MoM ISRO's status has increased. Now, NASA is talking about setting up a Joint Mars Working Group.
- The 30 September 2014 signing of an implementing agreement between the National Aeronautics and Space Administration (NASA) and Indian Space Research Organisation (ISRO) to conduct the joint NASA-ISRO Synthetic Aperture Radar (NISAR) mission.
- China and India recently signed an agreement on "peaceful uses of outer space." So, **many countries are now wanting to partner in ISRO's success.**
- Above all, such an achievement works as an **inspiration and catalyst for innovation** in the country and bringing more youth into the field of science.

## How ISRO succeed in making mars mission with relatively very low cost?

- **Less weight** of Payload so it is sent by PSLV itself and sending by PSLV is cheaper.
- ISRO first made the **entire blueprint based on available resources**, and no attempts were made on research for new techniques/technologies, particularly like designing and building a completely new rocket specifically for this mission.
- **Comparatively less salary to scientist:** ISRO pays its mid-level scientists around US\$ 1,500 to 2,000 per month while the monthly salary of NASA's scientists is about US\$6,000 and its top rocket-scientists get more than US\$10,000 per month.

## Should money be spent on such ventures?

- Humans are driven to explore the unknown, discover new worlds, push the boundaries of our scientific and technical limits, and then push further. The intangible desire to explore and challenge the boundaries of what we know and where we have been has provided benefits to our society for centuries.
- It is difficult to predict all the benefits that might accrue from something like the Mars mission, some of which may be intangible but nevertheless vital for the country in the long run. The most important of such benefits could well be to fire the imagination of young minds in this country, getting them to dream about possibilities for tomorrow.
- Also there are lots of economic, technological benefits as mentioned earlier.

## Should ISRO use resources to other important project instead of MARS mission?

- There's another issue as to why is ISRO spending so much time and money on a mission to Mars when it could be using those resources for better navigation and communication satellites - satellites that link the country better, satellites that are crucial to assess cyclones and floods here on earth.
- According to some experts with regard to priorities, we know there is severe shortage of communication transponders in the country.
- But in reply to such question the answer of Dr. Radhakrishnan was: "These are like five fingers of your hand. You require development in all those directions. You require communication transponders, that is, one of our priorities, yes. You require navigation satellites, we are already working on a network of navigation satellites. We are in the forefront in the world on satellite applications and we continue to be. But space science - about 7 to 8 per cent of our effort is towards science. We need it," And that's why, there is a lot more riding on ISRO's Mars Orbiter Mission than just a space craft that takes pictures and produces maps. So there is a need to develop such missions.

## Cons/Criticisms of MARS MISSION/is it wastage of resources?

- **Wastage of resources:** Some critics say that Crores of rupee wasted- could be used to remove hunger, malnutrition, improve sanitation. But it is baseless because of 2 reasons. Firstly, cost of 450 crore is not much as for Indians it works out to be about Rs.4 per person. Today, a bus ride would cost a lot more. Secondly, as reputation of ISRO has increased by demonstrating the capability of PSLV. So Now It might get more contracts from foreign countries which will help in recovering the project cost also.
- **Not a circular Orbit: Orbit is highly elliptical with closest distance 360 km and farthest is 80000 km.** As a result once in 4 days or so, it will have the closest approach to Mars. That too, maybe for 30-40 min. So this is the wrong kind of orbit to enable any clear observation of a planet.
- **Me too mission:** This is a **costly "me-too"** mission and would **merely** be a **duplication of other Mars probes. Non-readiness of the larger GSLV had forced India to use** a light-lift, low-cost rocket such as the liquid-engine-powered PSLV for propulsion.
- **Hasty and Less effective:** Its camera and other sensors are not as capable for probe as MAVEN's and other MARS missions. But still it is a significant achievement as for instance, In MAVEN only 10% spent on instruments, rest of the resources went to sending the mission to MARS and India has done this thing with very less spending.

## Comparison of India's Space research capability with China/ Is India ahead of China in space research?

- If the 20th century witnessed a “space race” between the U.S. and the USSR, the 21st century is seeing an Asian space race.
- In most aspects of space technology, China is way ahead of India. It has **larger rockets, bigger satellites** and several rocket ports. It even launched its **first astronaut in space** way back in 2003 and has a **space laboratory** in the making.
- In 2008, when India undertook its first mission to moon **Chandrayaan-1**, China raced ahead and orbited its **Chang'e-1** satellite ahead of India.
- But in this Martian marathon, India has reached the finish line ahead of China. For the record, ISRO's chairman Dr. K. Radhakrishnan has gone on record by saying, “We are not racing with anybody. We are racing with ourselves. We have to race to reach the next level of excellence.”

### Conclusion

After a journey of over 660 million kilometres that took 10 months, India's Mars Orbiter Mission has swept with effortless ease into orbit around the Red Planet, making this country the first to achieve such a feat in a maiden attempt. It is a tribute to ISRO and the professionalism of its scientists and engineers that every minute detail for such a complex mission could be attended to in the course of a project completed in just one and a half years. However, if the country wants to send heavier and more powerful spacecraft to Mars, it cannot do so with the Polar Satellite Launch Vehicle (PSLV) that was used for the current mission. So it is a big achievement but a lot needs to further enhance the capability of exploring MARS by sending heavier and more sophisticated missions to MARS.

**Copyright © by Vision IAS**

*All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS.*