

Chapter 2

Why Mars?

Mars is there, waiting to be reached.

Buzz Aldrin

The process of policy making is expected to be a rational process. Usually, the process involves a clear identification of the problem/issue at hand followed by overall assessment of the problem and recognition of the probable options and finally suggesting specific time-bound solutions. However, when the problems are complex, solutions are hard to come around and that at times even there is no clarity about the desired outputs, then the process of policy planning becomes extremely complicated. In many cases, technological and financial limitations restricts the process of policy planning. The process of policy planning could also be “political” where views, ideas, perceptions, lobbying, interest groups and way of negotiations play a vital role towards reaching a definitive conclusion.

Policy making in outer space arena has always been a challenge for both developed and developing states. Although the multiple objectives achieved by the satellite technologies are well known, still various concerns are found be raised with respect to new and innovative missions that are proposed to be undertaken in the space. This happens mainly because of the significant financial investments required for conceptualising new areas. At times, the sheer enormity of the project makes people disbelieve that the proposed idea is workable. Also, different analysts and policy makers view a range of ideas differently and offer their suggestions in regard to immediate priorities for the state. From a politician’s point of view whose period in power usually lasts for 4–5 years to make investments into projects which have gestation period of 10–15 years becomes difficult. All this further complicates the process of policy making in the space arena. Particularly for exotic and costly missions like humans visiting space or planetary missions where the mission objectives are somewhat ambiguous at this stage, various uncertainties do remain and policy decisions could always be challenged.

In respect of deep space missions, the missions to other planets about whom we know little and reaching there is both technologically and financially challenging

*Buzz Aldrin was the second person to walk on the Moon, quoted in http://www.jamiefoster science.com/education/podcasts/students/Samantha_Carroll/visit2mars/SamanthaCarrollVisit 2Mars.pdf, accessed on Apr 2, 2013.

such queries are always posed. Hence, the questions like “Why Mars?” and “Why Mars Now?” are found being raised in recent times since few states are planning missions to Mars. Perhaps such type of questions has no straightforward answers and could be argued either way. For a nation-state, there could be multiple reasons for undertaking such challenging and expensive projects. Also, it may not be necessary for every state undertaking such missions to have similar reasons. States could plan and invest in such missions for political, strategic, scientific, social and/or economical reasons. Hence, in order to appreciate the process of policy planning for undertaking such missions, it is important to carry out assessments at different levels of motivations for the states.

Every technology has its own importance and role. It may be incorrect to grade/value the technologies based on their direct scientific benefits alone. The “management” of technology involves reasons other than scientific. Strategic and commercial importance of a particular technology forces the states to invest more towards the development of that technology. Hence, few specific technologies could gain more prominence over others. The most obvious example of this is the nuclear technology. In regard to space technologies, similar trends are also visible. Nuclear and space technologies find greater relevance over other technologies essentially because of their strategic relevance. The application of nuclear and space technologies for peaceful purposes is actually far greater than its military utility. However, these technologies play a significantly important role in regard to determining the deterrence potential (includes nuclear weapons, delivery systems and reconnaissance assets) of a state. These technologies have significant political importance and there exists certain amount of ambivalence with respect of policy formulation in regard to usage and transfer of these technologies. Presently, various states are still in the phase of “experimenting” in the deep space arena and have less clarity in regard to the exact likely strategic gains from such investments. Hence, country’s policies for investments into missions like Mars mission needs to be viewed at the backdrop of the relevance of space technologies in the overall global order.

Global order is essentially a contested concept. It could be viewed as the political, economic or social situation in the world at a particular time and its effect on relationships between different countries [1]. It is difficult to offer an exact definition of the global order mainly because order is mostly viewed as dynamic idea and as a matter of degree. In various cases, at the conceptual level, there are always competing ideas of what constitutes national interests, desirable foreign policy goals and connected views of global order. Probably, where you stand on the matters of order also depends on where you sit in the global hierarchy. The global nuclear regime (non-proliferation treaty, NPT and other related treaty mechanisms) could be viewed to have played an important role towards the maintaining of global order [2]. However, in the Cold War era and post-Cold War era, few states are found using nuclear non-proliferation regime as a means to restrict access to few other states to the nuclear club. This also could be viewed as an attempt to restrict the global order. The question is, “would space technologies also meet a similar fate?” Probably, it is too premature to answer this question at

this stage but such issues could gain importance in years to come when humans would have achieved far more success with their space endeavours.

For effective maintenance of international order, it is also important to address various global challenges from nuclear proliferation, climate change, disaster management to terrorism collectively. In order to harmonise various state and non-state actors to accept the notion of global governance over the years, various processes of norms formation have been undertaken. Mostly the norms formation, international law, sustainable development and international relations, etc., could be viewed as constituents in respect of global order. The notion of globalisation which is essentially about the integration of economies of the world could also have its say in regard to global order.

Technology plays an important role in global order. Technology and globalisation are mostly mutually dependent. Since the beginning of the first industrial revolution in the eighteenth century, the technologies could be viewed to have played a greater role towards maintenance of the global order. The process of technological change spurs structural changes in the economy and society [3]. In a technology-driven global order, technological capabilities of a country are an important determinant of its competitive strength both at home and in the world market [4]. Nuclear technologies, space technologies and the military industrial complex have played an important role in the dynamics of the overall global order. America's success with the Moon mission in 1960s was viewed as a "victory" over the erstwhile USSR in Cold War era. In the present era beneath the changed geopolitical settings, it is important to situate the reasons for the investments in Mars programme in the broader context of global order.

Every nation-state intends to design their space policy as a subset of their overall national agenda. It is expected that the civil, commercial and military space policy would be designed to meet the practical demands and requirements of the state and mostly states are found catering for economic realities before making such investments. However, many a times the "motives" of the actors associated with the space policy making are also found dictating the future course of policy making. Individual and organisational interests also impact the process of policy making. At times, this leads to the evolution of space programmes and projects those may not be well optimised, costly and time consuming. Space policy has to accommodate a broad range of perceptions and interests, from practical issues of national defence, commerce and technology to less quantifiable characteristics such as the contribution of space exploration and development for societal benefits and to the achievement of humanity as a space-faring species [5].

The intellect and consciousness of human mind are always urging it to inquire more about the universe than what is known. In fact, the human fascination with the universe has been there for long and would always remain. For many years, scientists are working on various aspects of the Big Bang theory a prevailing cosmological model that describes the early explosive origin of the Universe. Humans have always kept their interest alive with regard to finding out about the presence of life on other planets or other solar systems. There is an interest to know about the birth of stars and planets. The field of the study of celestial objects

commonly known as Astronomy has attracted the attention of many inquisitive and brilliant minds. It could be traced back from the Galileo (1564–1642) period when he first looked at sky by constructing his own spyglass and then went on to construct the telescope. Since then, significant developments have taken place in the field of space sciences which essentially involves studying various known and unknown aspects of the outer space. Mainly the issues related to astronomy, planetary sciences and cosmology do get discussed under space sciences.

Human endeavour for space exploration could be for various reasons. Modern day space programmes could be categorised under two basic groupings. One, the agenda driven for knowing more about the universe, galaxies, unidentified matter, to reaching the planets in our solar system; and other is the agenda driven by developing technologies for launching satellites in low, medium and geostationary orbits and building space stations and carrying out experiments in the zero gravity atmosphere, undertaking robotic/human missions in low Earth orbits. One aspect of the space exploration could be essentially identified with the radars, astronomical outposts and ground- and space-based telescopes and theorists developing computer-based simulation models to know more about the galaxy formation, while the other facet of space exploration is about the satellites, spacecrafts, space stations and astronauts. It is important to note that both these groupings are considerably interdependent.

Post Sputnik, there has been a significant propaganda element associated with the exploration of the universe. In the Cold War era, reaching the Moon had more political messaging than actually gaining any knowledge about the Moon. But, the same may not be totally true in the twenty-first century. Probably, now various states are undertaking cost-benefit analysis before making major investments in the space exploration related projects. But, it is important to note that along with the economic costs, the states are also factoring in for the political and technological costs of their investments in space arena.

It is difficult to actually identify the exact reasons for the state to undertake mission to Mars. This is not to say that the states do not build up a perspective before undertaking such missions but the current endeavour is to know more about Mars and based on this knowledge decide the future course of action. A mission to Mars is also a subset of the overall space agenda of the state. Hence, investments into Mars could be viewed as a continuum of state's policies. Space-faring nations do plan to have their own "dream" missions in space and Mars is just a step in that journey. Planet Mars has some peculiar attractions for which the states are dreaming to reach there. In general, the quest for the red planet emerges out of its own logic.

Post the launch of Sputnik satellite by the erstwhile USSR during 1957 broadly, three priorities [6] for the development of space programmes by the states were identified:

1. Cold War era rivalries and desire to demonstrate the technological superiority
2. Lure of discovering unknown
3. Adventure

Presently, apart from the Cold War era rivalries, the other reasons mentioned above are still valid and could be viewed as motivations for the states to dream of Mars. Today, even in the post-Cold War era, the United States would not like to “loose” its technological leadership because it plays an important role in maintaining their superpower status. They are not oblivious to the fact about China’s attempts to make major inroads in the technology domain. The USA understands that China is using their space capabilities to demonstrate their technological proficiency. With China displaying the traits of emerging superpower, the USA is unlikely to surrender their leadership in space arena. Hence, Mars missions including the human Mars missions do have their own geopolitical insignificance.

Our solar system consists of the Sun and eight official planets. The inner solar system contains the Sun, Mercury, Venus, Earth and Mars. While the outer solar system planets are Jupiter, Saturn, Uranus and Neptune, while Pluto has now been classified as a dwarf planet during August 2006 (by the International Astronomical Union). For various reasons, it is been believed that apart from the Earth, probably the Mars could be the most habitable planet in our solar system. There are varieties of reasons for such beliefs. The length day over Mars is similar to Earth, around 24 h. Also, its gravity is 38 % that of Earth’s, which could be manageable for human survival. The ground temperatures over Mars range around 0–100 °C. It has an atmosphere which could provide protection from cosmic and the Sun’s radiation [7]. No other planet offers such manageable similarities with the Earth for a human stay. Also, Mars has its two Moons namely Phobos and Deimos and understanding more about them could also help to know more about “a planet and a Moon system”, in general. This could help to draw some inferences with regard to Earth–Moon system.

Human beings are trying to find an answer to a basic query that why Earth is such a beautiful place to live and would it always remain like that? Why the Earth is just right distance from the Sun—not too far for the oceans to freeze or not too close for the oceans to boil? Planetary scientists call it “Goldilocks Paradox”. It is argued that Earth and its two neighbouring planets Mars and Venus were formed around the same time about 4–6 billion years ago, from the same ingredients including water, carbon dioxide and nitrogen. But, only Earth developed life. Mars is too cold and Venus is too hot, but Earth is just right [8].

However, humans are yet to find the answer for such paradox. We are yet to find a theoretical backing for why do the laws of physics seem fine-tuned for life? The Mars exploration could help us to understand about the evolution of Earth. Probably, the study of other planet which has a matching DNA with Earth could help us to understand more about the origins of volcanoes, earthquakes and weather [9]. All such studies over a period of time could directly or indirectly benefit humans to address issues related to global warming/climate change and also forecasting of probable natural disasters.

It is important to note that climate change happens not only because of the factors originating on the Earth itself like human-specific impacts on the surroundings, but it could also occur because of the external factors like solar radiation received by the planet, etc. Also, scientists are trying to understand how the

variations in the Earth's climate by the changes in the characteristics of the Earth's orbit and axial tilt could take place. Study of current weather changes on Mars with changes in its atmospheric composition both due to on planet and outside planet factors could help to develop atmospheric models to understand changes in Earth weather [10].

Study of the Moons of Mars could help to know more about the asteroids in particular and the formation of the solar system in general. The study of Phobos and Deimos will tell us about the structural strength of asteroids and these Moons are also excellent sites for the study of impact processes. Exactly how craters come to look like craters is still a subject of some debate and Mars missions could help to find answers to this. As per one school of thought, crater morphology depends on the body's surface gravity while some other studies conclude that material strength and the impact velocity are of more importance. Maybe a Mars mission could allow us to reach to a singular conclusion. In addition, some first-hand knowledge could be gained in regard to how craters are created in a very low gravity environment. All this would help in better understanding of Earth [11]. There are many unanswered questions like why Earth is the only water-rich planet, was there water available on other planets too and if so, why did it disappear? Some answers to such question could help us to know the future of water on the Earth. Also, mission to Mars could assist in knowing more in various arenas from the planetary geophysics, from the knowledge about the role of carbon dioxide in the atmosphere to the evidence in regard to the life on Mars. It is known that Sun has a direct correlation with the weather on the Earth. However, because of the particular rotation of Earth and Sun at times, it is not possible to study all the properties of Sun from Earth. Such study could become possible from Mars.

Apart from various scientific benefits undertaking of Mars mission is expected to offer various technological benefits too. From Launcher to Lander, a range of technologies would be required to make the mission happen. Every new launch to the Mars would demand the development of additional technologies. Also, the complex nature of such missions would force the development of some innovative technologies.

Specific propulsion technologies would be required to provide the energy to get to Mars and conduct long-term studies. Entry, descent and landing technologies would be required to ensure precise and safe landings [12]. Nature of mission (human or robotic) would also dictate the requirement of additional technologies. There would be a requirement to invest into a range of different technologies from avionics to planetary protection technologies to remote sensing sensors to telecommunication technologies. Human travel and survival would necessitate investments into an array of new technologies. All this could lead to major development to the field of robotics, control systems, materials, communications, nano- and biotechnologies, artificial and ambient intelligence, etc. Subsequently, over a period of time, there are chances that various spinoff technologies could get developed in the fields of transportation, information and communication technologies, robotics, medicine, agriculture, etc.

No political leadership is expected to take decision in vacuum with regard to their state making investments in programmes like Mars mission. There has to be a justifiable case put forth by the scientific community in this regards explaining both the need for such a mission and their capabilities to successfully pull it through. Designing the right mission at the right budget is obviously a requirement for going forward [13]. At the same time, it is also important to note that a cost-benefit analysis purely based on economical viabilities may not be prudent to decide the fate of various new space missions. This is mainly because such investments may not look viable in short term but are likely to offer benefits in long term. Also, since various missions undertaken in space have direct or indirect benefits for society on range of activities from education to science research to disaster management, non-commercial funding for space is mandatory. Present phase is a period of Mars exploration; hence, the financial costs incurred should be viewed as an “investment”.

Political leadership is expected to play a very important role for a state to invest into programmes like Mars mission. A leader of celebrated vision and conviction could only appreciate the importance of such agendas for their state. Here, again the presence of a reputable technocrat, presenting a credible technology leadership is also vital. Presently, the financial crisis witnessed in the twenty-first century is restricting the space-faring nations to plan for gigantic space agendas. However, it is felt that a vigorous, focused, goal-oriented space programme would eventually bring more employment opportunities, assist industrial growth and open the spigots of technological innovation.

It is also felt that even though the investment would eventually come if is felt that there could be a reluctance to invest in human Mars programme. The present thinking appears to be more biased towards undertaking robotic missions. The perceived lack of interest in human space exploration could be because of two main reasons: one a fear of human casualties, and second a misguided belief that we must solve all our terrestrial problems before doing anything ambitious in space! [14] However, it is important for policy makers to appreciate that attempting to resolve only extremely difficult scientific challenges would help us advance further and Mars mission offers such options.

The question is “why Mars now?” A simple argument could be since more than 50 years have passed as humans have succeeded in reaching space if not now then when? Humans could be said to have started trying to understand the secrets of Mars since 1600s with the invention of telescope. In the space era, attempts have been made since early 1960s to study Mars by sending probes in the vicinity of Mars. This was happening as a part of the unmanned spacecraft interplanetary exploration programme undertaken by the erstwhile USSR and the US.

In early years, Mars was found unfriendly to Earth’s attempts to visit it. More missions have been attempted to Mars than to any other place in our Solar System (except the Moon), and almost 50 % attempts have failed. Various initial failures could have happened probably because Mars was the first planet Earth attempted to explore [15]. These failures have also taught us many lessons and assisted in making few subsequent missions more successful. But, still space powers are yet

to master the art of reaching Mars and some disappointments have occurred relatively recently. Luckily, some successful missions since 1996 have provided important data about Mars helping us to better understanding. This is helping a better planning for future missions.

One of the questions with regard to quest for Mars is that “are humans aiming for the mineral deposits on the Mars?” However, it is still premature to answer this question. No definitive information in regard to the Mars mineralogy is available. However, some studies are available providing the regional surface material distributions on Mars [16]. There are indications that the soil on the Mars surface could have volcanic origin. Also, clay minerals that usually form when water is present for long periods of time covering a larger portion of Mars than previously thought [17]. Mars has a different crust than Earth, and very different atmosphere and so the minerals over there are expected to be different than that of Earth [18]. Based on available information mapping of the Mars surface has been done by scientists which give a reasonable idea above the area for further studies and excavation from the mineralogy point of view. However, even if some useful minerals are found over there is it highly unlikely that they could be transported back to the Earth¹. The existing technology cycle even at its maturity peak would not offer effective, viable and economical solutions to transport back any material from Earth to Mars.

Another aspect of Mars which states are likely to consider in their assessment particularly from the point view of human missions to Mars is the climatic conditions over the Mars. Even though in comparative sense probably Mars could be the most habitable planet in our solar system after the Earth, still the issues related gravity, low temperatures and absence of atmosphere offers various challenges for a long human stay. Bulky equipments would be required to be carried for human sustenance posing various technological and economical challenges. All this to a greater extent could discourage the policy makers.

Also, there is an opinion that benefits projected from Mars mission are “vague” in nature and more clarity is required on actually what could be achieved from such missions. Hence, a policy maker could raise questions that “Is Mars worth the risk?” and “Worth the financial investments?” It is important to note that the space travel is analogue of national esteem and a momentous act like human visiting Mars is bound to bestow a great power status to the country. Hence, any myopic economic approach is not advocated. Also, the success of few recent missions to Mars particularly the success of the United States rover Curiosity should provide encouragement for the further research.

The argument like “there is a lack of real societal support for such costly missions” needs to be assessed appropriately. It needs to be appreciated that opinion polls conducted in regard to the efficacy of Mars mission have limited shelf value and do not always represent the view of majority. Moreover ill informed

¹ Ghosh A. A scientist working on NASA’s Mars programme has expressed this opinion while speaking with the author.

media debates on such issue vitiate the public opinion. On the other hand, success of missions such as Curiosity brings change in opinion of many people. People want their scientists to achieve stupendous successes with their missions in space. Also, scientific community is always keen to take calculated risks with their research and if they achieve a significant success then do get major public support for future missions.

Whether life has existed on Mars or not is still an open question. There is a need to undertake detailed biological experimentation including study of fossils in this regard. Humans are keen to get the answers with respect to presence of life outside Earth and are ready to make all efforts towards finding an answer to this. The nature of technological developments witnessed in space area bestows the confidence that albeit the human mission to Mars may be a difficult proposal but definitely not an impossible idea. Particularly, in the twenty-first century with few states already having acquired some amount of a success in knowing more about Mars, it is worth pushing the envelope further up. Overall conquering the Red Planet appears to be worth the risk.

It is obvious that the states would decide their Mars agenda based on their technological preparations once the policy decision to undertake a mission has been taken. However, there are only specific launch windows which are available when planning a launch mission is advisable. For an interplanetary launch, the window is constrained typically within a number of weeks by the location of Earth in its orbit around the Sun, in order to permit the vehicle to use Earth's orbital motion for its trajectory, while timing it to arrive at its destination when the target planet is in position. Every 26 months, Earth, Mars and the Sun align for the most efficient, least energy-consuming path between Earth and Mars [19]. Actual planning of any Mars mission would depend on the planetary alignments. States have to manage with such limited window availability. The present-day rocket technology allows the crafts launched from the Earth to reach Mars within 8–9 months. Scientists are working on various technological aspects with an aim to reduce this period significantly. For any future human mission to Mars, the one-way travel time of nine months to reach the Mars orbit is not particle.

In post-Cold War era, there have been always talks of space race particularly in Asian context and that too mainly involving the states like China and India. The reasons for this are obvious and mostly geopolitical. Such talks become loud particularly when both these states start planning for similar missions. Naturally, since both these states have interests in Mars, the issue of space race is getting discussed at various forums and particularly in media where there are many takers for such notion. It is important to appreciate that when comparison is carried out in respect of technology and budget investments, China is much ahead of India in space arena. Also, India is unlikely to view every Chinese investment in space as an act which needs to be responded suitably. In few cases, their programmes do have some commonalities and when such investments are scrutinised at the backdrop of geopolitical veracities, it is possible to (vaguely) conclude about the

possibility to race. In an interview with the author Joan Johnson-Freese² has following to say: “I am always sceptical about media reports on ‘space race’ activities for two reasons. First, very often reporters are not accurate in their reporting, and second, plans are only important if there is a budget attached. Very often I see statements about China’s long term goal of putting a man on the Moon, when in fact a manned lunar mission has not been approved in China and in fact has only recently been a topic of discussion. The ultimate goal of their three-step plan being implemented since the 1990s is a large space station. China has reaped significantly geostrategic benefits from their many achievements and ‘firsts’ as part of that program. But what comes next remains to be seen. They have launched one probe to Mars, Yinghuo-1, which failed. Clearly China would like to expand its interplanetary missions, but how rapidly and how aggressively remains to be seen. Yet clearly much of what is being done in space right now in Asia is for geo-strategic reasons. It appears to me that India’s plans to go to Mars with the Mangalyaan mission positions India to leap ahead of China in this one area—being only the fourth country/organization to reach Mars (with the United States, the then Soviet Union, and ESA)—ahead of China—whereas India has been behind China in other key areas of space exploration and development. What I will be watching in the future is which country is willing to put the required budget behind their plans to show not just the success of one mission which looks good in the record books, but a sustained programme of technology development and launches”.

Based on the overall debate in regard to various aspects of Mars agenda, the reasons for various states opting for the Mars mission could be identified as (1) fascination for the Red Planet, to know what it there, if life ever existed (2) technological challenge, humans have reached Moon so Mars is next logical step (3) to boost studies in space technologies (also spinoff technologies could offer additional benefits) and planetary sciences (4) nationalism, great power status and display of strategic superiority (5) economic advantages/boost to space industry.

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Lele, A.

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