Most Mars mission proposals have in general dealt with the transportation system to accomplish the trip, but few say what are the goals, scope and activities to be performed once reached the planet in order to keep going back and developing a manned future for the planet.

In this paper we want to analyze a potential sequence of missions that could lead to a future colonization of the planet and the conditions to make this happen.

Strategic decisions

The first and most important question that we must ask is: Why do we want to go? We have many answers but most of them can be summarized as follows:

- a manned first mission to Mars, to prove its feasibility and gain scientific knowledge

- a scientific mission and the search of potential life

- a first step toward future potential colonization

By deciding early on which could be the goals of the first mission, it is possible to adopt plans and technologies quite different, even for the first mission when the strategy to define the transportation system and local infrastructure must be geared to such goal, independently of cost, which is similar in any alternative.

As an example, if the final goal of reaching Mars could be its future and potential colonization, is it not economical and, at the end, extremely negative to follow a strategy whose main goal is just to send a manned mission to Mars and send the crew back?

With the Moon a similar strategy was followed: go there before somebody else does.

At the end it reached its goal but left not provision for the future; it didn't have any potential development, and the Moon has been left without a travel capability since the early 70s.

For Mars the strategy must be entirely different. For a basically similar cost for a first mission, it would be possible to obtain an Earth-Mars transportation system which could allow for future missions at an extremely low cost, since the system could be almost 100% reusable.

By following a more ambitious approach it is always possible to leave all the options open at no extra cost for future developments. Let's analyze such a possible plan.

Essential Mars

This plan consist of an entirely reusable, step by step approach to the first manned human mission to Mars but with the additional capability, compared to Mars Direct or NASA's reference mission, of allowing the creation of a space transportation system, entirely reusable, between the planets.

Such a plan has been studied keeping in mind the possibility of an entirely privately funded initiative where cost savings and maximum results are the main design parameters.

In particulars the design parameters are:

- utilization of off the shelf components as possible

- minimum functional complexity

- minimum number of missions

- reutilization of most equipment

- maximum safety

- maximum utilization of local resources

The Plan

The overall plan for a first mission to Mars consist of a total of four missions, two unmanned and two manned, following Buzz Aldrin cycler theories, reutilizing, where possible, the same equipment.

The general schedule consists of a total of 12 years from the go ahead to the return to Earth of the first manned crew. This schedule includes preliminary studies and tests for site selection and other support infrastructures for the first manned mission generally not considered in most reference plans.

Before describing the missions it is important to establish a time parameter which will be utilized in this article, the cycle.

The cycle is the time needed for an entire Earth to Mars mission and return. Assuming about nine months for the first Earth-Mars trip, about 550 days on Mars till the next convenient return mission and another nine months to go back to earth, a cycle consist of about three Earth years.

The Missions

Cycle 1- The Mars Support Mission

The scope of this unmanned mission is to provide all information for the site selection and infrastructure development for key component of the manned mission. This mission will require a booster for space accessibility and the insertion of a cycler bus in a permanent Earth-Mars cycler orbit for future utilization.

The cycler bus will consist of a:

- utilities module

- power generation system

- propulsion module

- navigation

- communication

A Mars module will be composed of:

An orbiter with:

- a remote chemical analyzer

- a photographic surveyor

- a communication system

A lander (to stay in orbit until a potential site is selected) with:

- rover with chemical analysis

- communication

Cycle 2 - Site Preparation Mission

Once the site is selected and taking advantage of the return passage of the cycler bus near earth, the second mission will have the scope to prepare the base for the first manned mission that will follow.

The existing cycler bus will be simply refuelled and will carry the necessary equipment to be landed on Mars.

The Mars module will consist of a lander with:

- power generation system

- communication system

- rover with manned capabilities

- life support production system

- site survey equipment

- AstroHab station module (a construction system for extraterrestrial stations developed by the author)

- shuttle for Mars departure

.Cycle 3 - First Manned Mission

This mission will carry the first men to Mars with the scope of organizing a local base and to stay for the time needed for the cycler to come back with a new crew.

The existing cycler bus will be again refueled and will carry the Mars lander consisting of:

- a Manned hab

- a shuttle for Mars departure (back-up)

During the mission the crew will assemble and utilize the AstroHab station, left by the previous mission together with all the necessary equipment and after the successful production on site of all the life support and fuel materials

Cycle 4 - The Return Manned Mars Mission

The scope of this mission is to start regular Earth-Mars trips with the existing equipment and return to earth the first crew.

By this time all components of the permanent transportation and infrastructural system will be in place and operating allowing continuous operation at minimum costs.

To complete such a system this mission will consist of:

- a manned hab and Mars shuttle lander for the cycler bus after refuelling

- any additional system for the lander

Having described the Essential Mars system we can proceed further and analyse what's necessary for further developments.

With well defined goals and results is possible to divide the develoment of Mars in three phases:

Phase 1- Exploration and Resource Mapping

This phase includes the four preceding cycles, but we must add at least a further mission to obtain most knowledge and capabilities to proceed to the next phase

At the end of this phase we will have an operating and affordable transportation and infrastructural system, the necessary life support systems in place and the needed resources, mapping and information to proceed.

Phase 2- Development of a Martian Technology

The main goals of this phase will be:

Technology development for:

- food production

- basic material manufacturing

- construction industry

- life support components

- development of a local logistic system

- a second or many mobile manned bases

- space port

- maintenance

- local roads

- utilities

- health facilities

- support facilities

- vehicles

Incentives will be necessary like privatisation of land ownership and business rights, while the crew would consist of multitask specialists and, to avoid too frequent returns, husband and wife teams all supported by single or multitask robots.

Once such activity, especially the self support local technologies is in place and another minimum of 5 more cycles at full speed, we can proceed to the following step.

Phase 3 - Development of a Martian Economy

The conditions for a Martian economy development should include the following:

Develop a free economic system to create:

- utilities companies

- logistic companies

- material mining and manufacturing

- construction industry

- space transportation

While the infrastructures will consist of:

- operational main base

- local transportation system

- automatic mining

- secondary settlements

- 100% autonomy

While these conditions can be met we have to consider a main difference from the Moon. While the Moon for its short distance can be consider an extension of Earth and capable of activities such as defence or tourism, Mars, due to its distance, can only be self-supporting and must be developed on its own with such activities that can support an economy.

Furthermore the only possibility for an economy to exist, if not for a profit but at least as a justifiable activity, is to increase the number of people who will participate.

A scientific base with say, 100 people, will never justify a local economy and will be an end in itself. For this reason a local economy can only grow with the development of local human colonies as populated as possible, and whose incentive for existence and development lies only in a future terraforming plan and activity.

In particular the final conclusions show how the Martian economy is almost completely independent from Earth’s as a basic condition for its profitability and further development. At the same time, many support and research activities can be performed on Earth to allow economies of the scale that would justify the entire extarterrestrial economies. Due to the particular local economic conditions, the need to terraform the planet is a long range but indispensable requirement to keep an active and thriving a local economy.