System Integration of Future Space Infrastructure with involvement of Modern Expert Analysis Techniques

O. Saprykin, A. Kul`chitsky, A. Botvinko, N. Feklyunin

Central Research Institute of Machine Building (TSNIIMASH)
4, Pionerskaya str., Korolev, Moscow reg., 141070, Russia

This paper presents methods of a Future Space Infrastructure (FSI) forming and evolution analysis.

A space infrastructure of the future should provide solution of all future space research and exploration tasks for the next 50 years. This determines requirements to the components forming the infrastructure and to the FSI as an entire system.

To solve this future task one should provide realization of some basic functions. Research and exploration tusks are considered with reference to the following space domains:

- Earth and near-Earth space;
- Moon and near-Moon space;
- Mars, near-Mars space and asteroids.

Each FSI component realizes its basic function in its space domain. Implementation of a complete set of basic functions provides solution of all research and exploration tusks in a long-term period. The FSI is a composition of components which perform all basic functions in all concerned space domains.

Forming and evolution of the FSI is based on a number of principles. A list of 13 such principles is represented in this paper. An expert analysis technique for generating FSI options is based on integral assessment of each FSI component degree of conformity to the principles of FSI forming with respect to 49 criteria. According to the carried out analysis identified are tentative time terms of FSI component establishment and schedule of its components demand to solve future tasks.

The principles of FSI creation do not fix any certain order of future tasks solving. The infrastructure being build up should provide at each phase solution of maximum quantity of exploration tasks. However the performed studies showed that in the course of FSI forming there are three distinctly traceable phases of space exploration: further exploration of near-Earth space, exploration of the Moon and exploration of Mars and other deep space objects.

Future interplanetary projects require considerable resource outlays. Building a future infrastructure by one nation may face essential shortage of resources. The developed method allows taking into account levels of resource limitation. By limitation levels three FSI forming options are identified and conditionally named “minimum”, “medium” and “maximum”. The limitations identify both schedule of an FSI component establishment and the infrastructure configuration for each time period.

Within the next decades implementation of large-scale space exploration projects will be viable only by means of international cooperation. Establishment and perfection of an international space infrastructure will make it possible to reduce duration of development of space facilities needed for implementation of various space projects and increase their scientific and economic efficiency.