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## QUALITY OF LIFE IN THE FOLLOWING CENTURIES

**Abstract:** *The quality of people's life at the end of the 21st century, or at the end of the 22nd century can only be considered as a part of scientific and technological development forecasting for these periods. Namely, the rapid population growth on the planet requires a whole new philosophy of sustainability of human population. It should be more and more focused on the cosmic vastness and its settling. This includes the migration of millions of people and the creation of permanent settlements in the near and far space. But the immediate question is what the adequate life habitats for many people are. At the same time, two adaptations for life must be provided: adaptation of new habitats and human adaptation to the new living conditions. This is exactly a critical stage of life and further development and growth of population in the new habitat. Quality of life at this stage is reduced to survival and establishment of the normal life flow. This paper seeks the answers to questions what dimensions of life quality and what indicators will be dominant at this stage at new habitats in the cosmic space. What are the key stressors and risks for the survival and development of new settlements and the speed and quality of adaptation to the new living conditions, growth and development of a new civilization are also the issues that are discussed in this paper. And finally, how the philosophies of life, culture and value systems in new, dramatically changed conditions of life are changed? All these issues are essential for human civilization in the following centuries.*

**Keywords:** *life quality, the following centuries, scientific and technological trends, resilience, life quality indicators, cosmic engineering*

### 1. INTRODUCTION

What does the Humanity strive to and what are its outcomes in the following decades and centuries? What will the world look like at the end of the 21st, 22nd and 23rd century? These are the questions whose answers define the new philosophy/philosophies of life, life quality and happiness of people. Of course, at this moment, it can only be talked about predictions, but the directions of development are certain. To what extent they will be realized remains uncertain, but foundations of new civilization/civilizations can be set with great certainty. Those will arise in brand new conditions and environment that will not be like parent planet.

But for this to happen it is necessary to solve many problems in this century which answers should be given by science and technology. The settling of the surrounding outer space requires sufficient amounts of energy, new intelligent materials and devices, new knowledge about adaptation and transformation of man for living in new conditions. Further, in order to develop civilizations on planets and satellites of the solar system, it is necessary to develop a sustainable system to ensure the necessary amounts of air, water and food, along with all other necessary adaptations of human organism to new conditions (gravity, brightness, pressure, etc.).

Also, the population of the Earth must be prepared for many new challenges, such as

global warming, ice age, the depletion of natural resources, etc. So, the humanity must simultaneously solve two extremely complex problems (1) the survival of the Earth planet, (2) migration and the creation of new civilization(s) in space.

It must be deeply aware that the time of earthly paradise is at an end and that the living conditions will be more complex and more vulnerable, and that the life quality, both objective and subjective, will decrease significantly, reduced to mere survival in the critical periods. Everything can be overcome if we are wise and united enough and if we, as the mankind make efforts towards further development of our own civilization. Here, each individual elevation with wealth and power leads to downfall. The wealth and power have to be civilizational attributes for finding optimal solutions for the growth and progress of humankind as a whole. A man or a certain group of people are doomed to fail no matter how rich and powerful they are, as they can never possess the knowledge and strength of the entire mankind.

## **2. THE EXPECTED SCIENTIFIC AND TECHNOLOGICAL PROGRESS BY THE END OF THE 21ST CENTURY**

First of all, the expected scientific and technological progress in the 21st century should be analyzed, as well as the progress of mankind from all aspects, from the natural, social, scientific to security. What is clear is the fact that we have very limited natural resources on the planet and the enormous population growth, which accelerates their consumption. Exhaustion of natural resources harms the people's life quality, and their survival over a longer period of time. In order to perceive it all, it is necessary to thoroughly analyze all aspects relevant to the development of humanity until the end of the 21st century.

In order to avoid or mitigate the effects of global warming and cooling, the human community must seek appropriate solutions, in accordance with the knowledge and technologies it possesses, but to develop them rapidly as well, because there is no time to spare. Some possible solutions are:

- (1) Adaptation of the human community to climate changes
- (2) Creation of settlements in the polar

areas, under water and / or underground

(3) Moving a part of human population in the nearby outer space.

In the last century there were a lot of profound technological, economic and social transformations. It was a century of great world wars as well. The development of science was going upward, new physical theories (the theory of relativity, quantum mechanics, micro-particles, astrophysics...), informatics, genetics, nano-materials, medicine, etc. In the first decades of this century, the advances in science and technology continue at the same pace with the expectation of new scientific theories and advanced technologies. According to Kondratieff long waves of development we are in full development of the information age at the moment.

With the rapid advances in information and communication technologies, the dominant scientific fields in the 21st century will be:

- genetics
- energy
- advanced materials
- brain and consciousness
- information and communication
- Environment (preservation and protection).

Researches in these areas are expected to bring the following technological achievements in the coming decades:

- Planetary engineering, for example, disposal of waste in the earth layer
- Ocean mining
- Oceanic farms / agriculture
- Brain technologies
- Smartness in all devices, components and systems
- Modification of weather (climate)
- Products and systems at the nano level
- Space stations
- Planned terraforming

This is, of course, just an example of a part of new technologies that will be developed and implemented by the end of this century. At the same time, several scientific fields and technologies will be integrated, such as intelligent nano and nano-bio robots independent from energy sources and which can be used in the conquest of outer space and terraforming of suitable planets or other space objects at which people can live.

## 2.1. Settlements on the Earth (water, polar areas, underground)

In expectation of significant global climate changes in the following decades, especially global warming of the planet, as well as rapid population growth, human society has to seek new solutions for adequate habitats / settlements on the Earth. A completely new architecture and new materials for current settlements - cities under the dome which eliminates the overheating of cities and protects from low temperatures in winter. Also, the construction of settlements in the seas and oceans, with complete infrastructure for living is planned, settlements under the ground and settlements in polar areas (in the snow and ice).

### (1) Settlements under water

Settlements under water are those in the seas and oceans, with complete infrastructure for housing and carrying out economic activities, as well as with farms for cultivation of animal and plant food for the purposes of the population. Living there requires significant adaptation of the human organism to the living conditions in water. This surely leads to the development of changed living philosophy and views on the welfare and quality of life in general. Classical landscapes, solid ground, the appearance of the sky, etc. will be lost, and it requires the psychological adaptation of people as well.

### (2) Life underground

Settlements and houses under the ground also require adaptation of people to the new conditions, as the width of space, sky, direct sunlight, and the feeling of being underground are mostly absent. In this case, most of the agricultural activities take place on the surface of the earth.

### (3) Settlements in the polar areas

The harsh polar climate, with low winter temperatures is not suitable for human life, but with appropriate adaptations and architecture polar cities comfortable for life can be built. They can be built in ice and snow, but also under water in the polar seas. Of course, they are connected with business, primarily agricultural activities near the Arctic Circle suitable for food production.

## 2.2. Settlements in the solar system

Due to excessive population growth on the planet and limited natural resources, human population is focused on colonization and cultivation of the surrounding outer space, primarily solar system. Here is primarily thought to the colonization of asteroids, the Moon and Mars, and in the distant future, the colonization of other planets (mainly their satellites) and eventually the entire interstellar space of our galaxy. Namely, the time will come to develop new cosmic civilizations that will significantly differ, regardless of arising from the same core.

In order to establish sustainable settlements anywhere in outer space, it is necessary to provide a series of conditions for a normal and decent life of people. This requires solving a large number of very complex issues. The first and perhaps the most difficult problem is to provide at least approximate physical living conditions (gravity, atmosphere, pressure, illumination, water, temperature, etc.). We still do not know what the minimum requirements for biological adaptation of the man in the cosmic space are, primarily for permanent residence and the development of new generations of people. We do not know how these parameters affect the changes in the human body, even when the changes of environmental parameters are relatively small (gravity, radiation, etc.). As for the other issues, such as energy, provision of material goods for normal life, development of society and everything else that is necessary for the development of new colonies and its transformation into a civilization, there is not even minimum knowledge for their permanent solution and successful survival of human community in new conditions.

Of course, the quality of life in the early colonies outside the Earth will not be even nearly at the level of the earth. Inhospitable environment, permanent risks for the life of individuals and their families or collapse / destruction of a colony will make the living cruel and will require great effort and constant struggle for survival. The basic postulate of happiness of individuals and community will be the survival and most probably the slow progress of the colony. These are teething troubles of each new civilization and their development will depend on the degree of

adaptation and knowledge.

We will briefly analyze the possibility of development of permanent colonies on the Moon and Mars. This is very important from the point of impact of the changed basic conditions on the quality of life and happiness of people.

(1) Settlements on the Moon

The Moon is the closest space object and in terms of time, energy and transport the most favorable for colonization. But let us first analyze the physical characteristics of the two celestial bodies. According to known data, it is clear that the conditions for the life of man on the Moon are more than cruel. Life is possible only in special settlements where it is possible to provide the basic living conditions the some extent. Nevertheless the issue of the possibility of man adaptation to live on the moon still remains, both from the physical and psychological aspects (at least in the foreseeable future). By the end of this century, it is possible to build research stations and possibly the less tourist facilities. In both cases these are not settlements for continuing life on the Moon.

Construction of the first settlements will require major engineering and construction efforts. The first major problem is the energy needed to transport materials and basic facility elements to the settlement. Another major problem is the reliable and sustainable solution to ensure the minimum conditions for human life. The appearance of a base on the Moon is shown in Figure 1.



Figure 1 The appearance of a base on the moon which construction is planned in 2050

Mars is the closest planet to Earth that has the most favourable conditions for colonization. Other planets of the solar system are either hot or gaseous with a high gravity and are not suitable for the construction of human settlements at least for the time being.

If we analyze the characteristics of Mars and the Earth, it can be seen that Mars is relatively favourable for colonization (Table 1). The conditions for living on Mars are surely cruel, but with proper planning of settlements the survival of the human colonies is possible in the long term. When mankind acquires sufficient knowledge about the fundamental principles of the existence, it will be able to begin the substantive terraforming of Mars, which would create favourable conditions for life of humans and other biological systems that have evolved on the Earth.

Table 1. Comparative characteristics of Mars and Earth

Parameter	Mars	Earth	Ratio Mars/Earth
1	2	3	4
<b>BASIC</b>			
Mass (10 <sup>24</sup> kg)	0,64	5,97	0,11
Equatorial radius (km)	3397	6378	0,53
Density (kg/m <sup>3</sup> )	3933	5515	0,71
The gravity on the surface (m/s <sup>2</sup> )	3,71	9,78	0,38
The speed of leaving (cosmic body) (km/s)	5,03	11,19	0,45
Solar irradiation (w/m <sup>2</sup> )	589	1368	0,43
Topographic range (km)	30	20	1,5
<b>ORBITAL</b>			
The main axis (10 <sup>6</sup> km)	227,9	149,6	1,52
Period of orbit circuit (days)	686,98	365,25	1,88
Orbit eccentricity	0,093	0,017	5,6
Length of the day (hours)	24,66	24	1,03
Orbit obliquity (degree)	25,19	23,45	1,07
<b>SEASONS</b>			
<i>Northern hemisphere</i>	earth days	days	
Spring	171	93	1,84
Summer	199	94	2,12
Autumn	171	89	1,92
Winter	146	89	1,64
Average temperature (in °C)	-60	+15	
Daily range (in °C)	-90 do -30	+10 do +20	
Maximum temperature (in °C)	+20	+50	

In expectation of the first human mission to Mars (about 2030), research institutions already work on the projects of first permanent settlements on Mars.

### 3. QUALITY OF LIFE ON THE EDGE OF THE CENTURIES (21st and 22nd, 22nd and 23rd centuries)

Due to rapid changes in the development of new technologies, new products and production systems, new knowledge and social organization, philosophy and lifestyles are dynamically changing, thus the quality of life in general. Changes in the quality of life occur along all axes (economy, society, environment, science and technology and value systems). The impacts on the quality of life in terms of the environment in which the human community exists should be separately analyzed:

- Classic natural environment of man on the Earth
- Life in special conditions on the Earth (under water, underground and in the polar areas)
- Life in the Universe (asteroids, the Moon, Mars, etc.).

This paper considers the quality of life of future human communities that will live in the special conditions on the Earth and in a nearby cosmic space.

#### 3.1. Life in special natural conditions on the Earth (water, snow and ice, underground)

Life in the special conditions on the Earth will be imposed by huge climate changes (global warming and / or icing). This will require the life in the seas / oceans, underground and Arctic regions. This will bring to the adaptation of man and his life, but of all his activities as well, from food production to industry. Let's consider the changes that occur in all five dimensions of life quality, and which are the new dimensions that should be introduced in the model (Figure 2).

##### a) Economic dimension

Here we consider an economy that is taking place in specific natural conditions on the Earth. The man needs to develop technologies and knowledge for life in the water and to develop economy of seas and

oceans, underground economy and the economy of the Arctic in these conditions. This economics will certainly be associated with classical economics that takes place on the surface of the earth. Production of food and drinking water in the seas (under water) for large settlements is a big research challenge for modern science. Getting energy, mining at the bottom of the sea and industrial production require new knowledge and new technologies. The effectiveness and sustainability of the economy in the new natural environments will require great efforts and sacrifice of the people, and material wealth of the new community will, at least initially, be well below the wealth that economy provides on the surface of the earth and it will significantly affect the quality of life and happiness of people. Of course, the economy will provide much better living conditions in the 22nd and 23rd century, but only after the formation of new sub-civilizations and the arrival of new generations of people.

##### b) Social dimension

Researching social organization and development of human communities in specific natural conditions is particularly interesting. This is because the responsibility of each member of the community is very high, primarily in terms of security. Imagine what can happen if you carelessly maintain a city / settlement under water: the whole community is absolutely in danger. This takes precedence over philosophy of enrichment and power, because only joint efforts can provide safe and sustainable life under water. Social relations have to be on a very high level and everyone has to know their role in ensuring the sustainable development of the community. That sense of community and caring for each member of the community is a prerequisite for a good quality of life and happiness of people.

##### c) Environmental dimension

It is this dimension of quality of life that suffers the biggest changes. It is one thing to live on the surface of the planet; it's another to live under water, underground, under the ice and snow. In these conditions, the degree of vulnerability of an individual and community is far greater than on the surface of the earth where man lives for millennia. In these specific circumstances there is no enough sunlight, the

air has to be supplied externally, the space is often limited, there is no scenery, drinking water has to be supplied in other ways, the same for food, and there is no view at the night starry sky. It is a traumatic environment and a lot of generations has to pass it to get used to this kind of environment and to accept it as normal. However, the man is on his parent planet and can get out on its surface whenever he wants space and its depth.

d) Science and Technology dimension

The dimension of science and technology becomes dominant for life in the special conditions. In fact, depending on the knowledge and technological achievements, the survival and further development of human communities will depend in the long run. How should we design the cities in water to withstand all the mechanical and chemical effects, how should we provide sufficient quantities of air and water, how should we produce enough food in the marine environment (not just fish and algae), how should we organize social life so the people are satisfied, and the quality of life and happiness

of people at a high level? There is no sustainable development of human communities in these conditions without answering to these questions.

e) Value system dimension

This dimension suffers significant changes because it is affected by the life philosophy that is derived from the parameters of the new environment. However, the main principles of the value system remain the same (freedom, justice, equality). Of course, for people who live in the classical natural environment on the Earth, the term under water, underground and under the ice is something the man is chary about. The man is a drowned man under water, a dead man underground and under the ice, and it is deeply ingrained in the psyche of the people both through the rituals and culture it is the world of the dead. Thus, after a certain number of generations, living in special conditions on the Earth becomes normal, but the value systems are significantly changed. All this certainly affects the quality of life of people and their happiness.

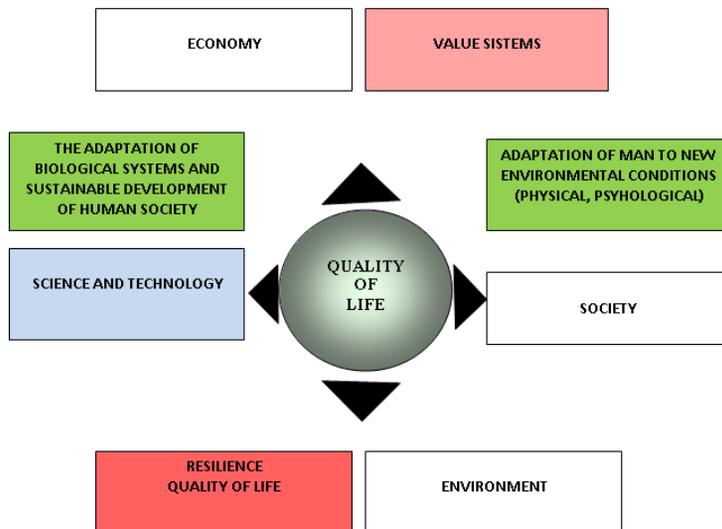


Figure 2 - The model of quality of life for special natural conditions on Earth

f) The dimension of human adaptation to new natural conditions

Man as a complex biological system lives by the principles determined by the nature, and these are gravity, brightness, change of day and

night, the seasons, the atmosphere, climate, land / relief, seas and oceans, the pressure and temperature at the earth's surface, the level of radiation, sound / noise etc. If anything of these changes, the body and consciousness react. These changes may partly affect the man, but

may highly endanger his life. In principle, all this requires human adaptation to new environmental conditions:

- physical (human body)
- mental (consciousness).

The adaptation of the human organism to specific environmental conditions on Earth includes:

- lack of natural light
- lack of day and night
- lack of seasons
- lack of climate (sun, heat, clouds, rain, snow, wind, etc.)
- lack of space and lack of relief
- a view into the depths of the universe (at night)
- atmospheric pressure variations, etc.

When it comes to the human psyche, adaptation to specific environmental conditions on Earth includes:

- sleep disorder (lack of day and night)
- the feeling of being under water, ground or ice (a sense of fear and discomfort)
- lack of space (no deep and primal beauty)
- depression (artificial light, artificial world, movement restrictions, etc.)
- visually poor world
- lack of sounds and supporting effects, new sounds and vibrations, etc.

g) Dimension of adaptation of biological systems to new natural conditions and the sustainable development of human society

For normal development of human community, the certain biological systems which provide food, water and drinks, but also the appropriate raw materials necessary to man are essential. Of course, in the case of life under water, the production of algae, fish and other marine animals is not sufficient. The needs of the body require much broader range of food (milk, fruits, vegetables, etc.).

Change of natural conditions, as well as in humans, requires adaptation of biological systems and the sustainability of the human population depends on its success. Thus, adaptation of biological systems includes:

- physical (biological organisms)
- psychological (behaviour of living beings in new living conditions).

Adaptation of biological organisms to

specific environmental conditions on Earth includes:

- lack of natural light
- lack of day and night
- lack of the seasons
- lack of climate (sun, heat, clouds, rain, snow, wind, etc.)
- changes in atmospheric pressure, etc.

When it comes to the behaviour of biological systems, adaptation to specific environmental conditions on Earth includes:

- disorder due to the lack of natural light (lack of the day and night – animals' dreams, photosynthesis of plants)
- discomfort for being under water, ground or ice (a feeling of fear or anxiety)
- depression of animals and plants (artificial light, artificial world, limited movement, etc.)
- lack of sounds and supporting effects, new sounds and vibrations (fear and distress of animals), etc..

On the other hand, the sustainability of human society in special natural conditions on Earth depends not only on the adaptation of necessary biological systems, but also on other natural and social systems necessary for normal life of a man. This primarily involves:

- good conditions for the sustainable production of food and drinking water
- rich and cost-effective energy sources
- sustainable natural resources necessary for normal life and development of the human population
- sustainable economic and industrial development
- adequate and sustainable social development
- adequate scientific and technological development, etc.

Due to specific living conditions and a high level of vulnerability, social organization and relationships within it cannot be the same as in the normal conditions of life on the Earth. They require much greater respect and unity in order to ensure normal living conditions and minimize the risks of possible disasters. The philosophy of life is significantly changed, thus the understanding of quality of life and happiness of individuals and society as a whole.

New dimensions of life quality have the dominant role in this.

d) Dimension of resilience of sustainable quality of life

The elasticity of the quality of life to the threats that come from the environment (external, internal), and which can be expected, and even more often unexpected, is extremely important dimension for the survival of the human population in specific living conditions. The level of resistance, primarily of living systems for a long-term life in water (sea, ocean), under the ice and snow and underground defines the ability for sustainable life in these conditions, and its quality. This is not about a measurement of resistance of life to new living conditions and improvement, but about its planning, design and establishment in order to ensure a high level of elasticity at all events that can disrupt life or destroy it at the bottom line. This is a very complex and responsible job in development of new sub-civilizations.

The process of creating a resistance / elasticity is carried out through the following stages:

(1) Analysis of conditions in which the living system should exist in long term: man, flora and fauna.

(2) Analysis of the possibilities and conditions for the functioning of living systems in new habitat(s).

(3) Design of functioning system and the resistance of living systems to new habitat (alterations, transformations, terraforming, response(s) to environmental threats).

(4) Creation of the habitat (settlements, cities), and the entire infrastructure of resistance / elasticity

(5) Monitoring, planning check of the resilience infrastructure (measurement of the resilience level, the state of resilience system, response to threats and strengthening of resilience.

During the process of planning, designing and construction of resilience systems for living in new conditions, the following elements of the system should be included:

- absorption – The system should be able to withstand disruption (damage) at the level of design.
- restructuring – The system should be able to restructure itself.

- upgrading – The system should be able to be repaired.
- drift correction – When it reaches the limit of elasticity, the system should be able to avoid or to perform corrective measures; operation can be carried out by opposing in real time or avoiding latent hazards.
- interaction through the scale – Each node of the system should be able to communicate and cooperate with each other node in the system.
- avoiding complexity – The system should not be more complicated than necessary.
- functional redundancy – There should be two or more independent and physically different ways to perform a critical task.
- physical redundancy – The system should possess two or more independent and identical prongs when performing critical tasks.
- Defense in depth – The system should have a capacity of two or more ways to address individual vulnerability.
- Human courage – The man should always be in the system when there is a need for human cognition.
- loose connection – The system should have the capacity to limit the cascading failures with the deliberate delays in nodes.
- modularity – functionality of the system should be distributed through different nodes of the system, so that if one node is damaged or destroyed, the remaining nodes will continue to function.
- neutral state – Human agents should make reasonable decisions in the course of action about what could be the best action.
- reduce the hidden interaction – potentially harmful interactions between the system elements should be reduced.

It should also be borne in mind that the dimensions of resilience applies to all systems involved in the life of a man under specific conditions on the Earth (from man and his adaptation to the economy, security and

science).

### 3.2. Life in space environment (asteroids, the Moon, Mars...)

Living in the space environment makes a man loses direct contact with his home planet. On the other hand, the living conditions are far harsher, than in the specific conditions on Earth. Also, there we cannot rely on the parent human community, but the new human community and the individual are alone with themselves (at least in the beginning of the creation of a new civilization). These are the destined advancements of the Earth civilization and their immortality depends on them.

In this case, all five dimensions of quality of life suffer great changes, and beside them the four dominant new dimensions emerge:

- Dimension of human adaptation to new natural conditions
- Dimension of biological systems adaptation and the sustainable development of human society
- Dimension of development of a new space civilization
- Resilience dimension of quality of life.

The structure of all nine dimensions of quality of life will be considered in the following text (Figure 5).

#### a) Economic dimension

How will the economic structure of human society on the moon or Mars look like? Is it possible to talk about private equity and market economy? No, none of that, it will be the economy of mere survival with an attempt of gradual development of the community. These will be stressful economies related to dimensions of adaptation of man as a biological system and adaptation of biological systems necessary for human life and its survival in a hostile world. Only after a large number of generations of people can we talk about serious economic development leading to the creation of a new civilization. If the effective means of transport are developed, some form of support from the home planet economy is possible.

#### b) Social dimension

This dimension will not be able to follow the development that takes place on Earth. Here in the harsh conditions of survival people must

be leaning on each other, and the fellowship must be dominant in relation to the selfishness of individuals and groups. The idea of globalism here melts like snow under the July sun. Here all are important as the different philosophy leads the fragile human community to the collapse and it takes a long time to it to start up a strong development that leads to the development of a new human civilization.

#### c) Environmental dimension

Environmental dimension suffers radical changes, because we talk about very harsh living conditions that have to be adapted with the help of the latest knowledge and technologies. So, virtually there is no atmosphere on the Moon, gravity is six times smaller, one side of the Moon is extremely hot, and the other is extremely cold and the entire Moon is a huge stone desert. There is no running water, nor is it possible to produce food in the open. And a number of other parameters of the Moon indicate a totally inhospitable celestial body. Knowledge of terraforming the Moon are absolutely at the beginning and are related to the huge energy regardless of the process (the development of the atmosphere, clouds and rain, the development of vegetation and wildlife, etc.). Even in the 22nd century, it will be a problem and a huge scientific endeavour which should be solved with the enormous and concerted efforts.

#### d) Science and Technology dimension

This dimension of quality of life in cosmic conditions becomes dominant. It needs to find effective solutions for high-quality adaptation of man as a biological system to new radically altered environmental conditions, as well as an efficient and sustainable growth and development of human communities, which should enable the development of new cosmic civilizations. Of course, it also means an effectively terraforming of celestial bodies, for example, Mars and the Moon. To begin with, the scientific and technological development of new human communities and / or civilizations must rely on the capacities of the parent planet, but eventually the development of own scientific capacities will create conditions for a normal and decent life of people in cosmic environment.

#### e) Value system dimension

This dimension of quality of life will also experience important changes. Philosophical views on life, the basic value systems, cultures and beliefs will assume many new forms. On the other hand, the new environmental conditions (gravity, brightness, atmospheric pressure, etc.) will significantly change the man's physical appearance, and the absence of earthly paradise (rivers, seas, lakes, flora and fauna, atmospheric phenomena, etc.) will significantly change the psyche of people. This will affect the development of the significantly changed system of values and views on quality of life and enjoyment of happiness.

f) The dimension of human adaptation to new natural conditions

This is the dimension that determines whether the human life is even possible on a celestial body. The level of effectiveness of adaptation determines how long a person can survive in the new living conditions. Therefore the adaptation of a man as a biological system to permanent residence in cosmic conditions is important (cosmic body, interplanetary, intergalactic space). Adaptation goes in two directions: (1) adaptation of a man, (2) adaptation of the conditions in the cosmos to the human needs (terraforming). The establishment of conditions for normal human life and sustainable development of a new human community will depend on these two processes, and accordingly the quality of life and happiness of people.

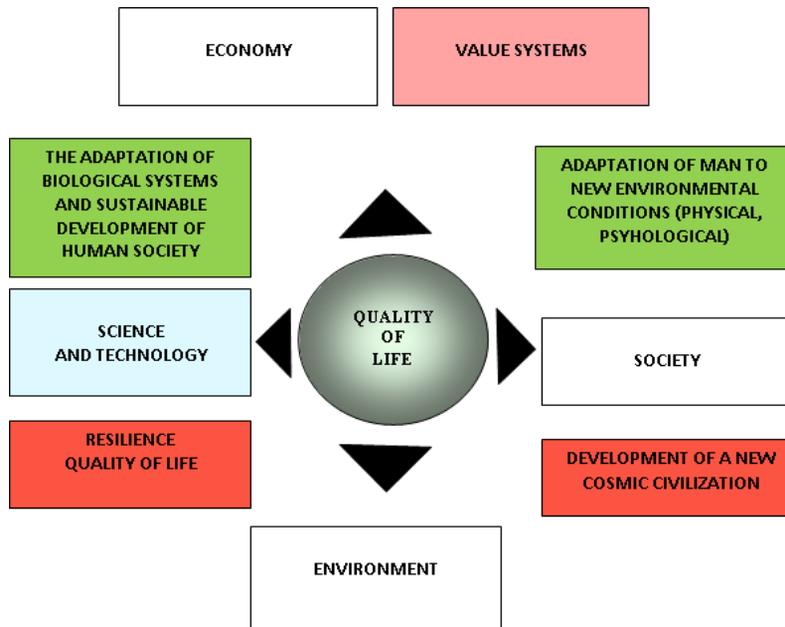
g) The dimension of adaptation of biological systems and the sustainable development of human society

Adaptation of a man as a biological system to new living conditions a necessary but not sufficient condition for human life in space conditions. Namely, in order to survive and develop the human community in the universe, the adaptation of those biological systems without which the human life is not possible is also necessary (the production of oxygen, water, food, etc.). This is an extra effort and research challenge as it requires the solution of terraforming problem of a particular celestial body (Mars, the Moon, etc.). Adaptation of these biological systems must be brought up to the level that they normally reproduce and develop, thus ensuring the growth and development of the human community in a very

long term. On the other hand, the sustainable development of human society in the space environment also depends on many other factors, such as the provision of sufficient quantities of energy, infrastructure, construction of educational institutions, construction of research and development institutions, efficient transportation, and establishment of a series of economic activities, primarily industrial. And all this does not have to be the same as at the parent planet even from afar. Therefore, new knowledge and new technologies are needed, appropriate to the new environment and living conditions. Perhaps the man at the end of 22nd century will be capable of coping with the current spatial and temporal distance and to perform its current adaptation and transformation using the theory of ether, from the physical and mental aspects. This would radically change the relationship of man and humanity towards the space, the entire world and life in general. Whether a human colony is formed in the space environment (the Moon, Mars, etc.) with the help of current knowledge and technologies, or a brand new fundamental knowledge is used in the future, the colonies formed are the core of future space civilizations. These civilizations will be formed in accordance with the new natural environment and living conditions. They will be shaped by:

- new philosophy of life and a way of life
- different view of reality
- different appearance of adapted humans (after the change of a large number of generations)
- the changed value systems
- new natural environment
- new culture
- different beliefs
- different vision of beauty and delight
- different attitude towards the struggle for survival of the human community
- different understanding of communion
- significantly different art, etc.

They will of course contain within a lot of its parent civilization, but as the time is passed, they will be more and more different. This results in a different view of the quality of life and happiness of the individual and a new human community.



*Figure - The model of life quality in space environment 3*

The resilience of biological organisms, i.e. the possibility of flexibility and resilience to the effects of new and radically new living conditions (water, outer space and the body) certainly has a very important role in all adaptations to new conditions, either it is about global warming and / or cooling the planet, life under water, underground and / or under ice, or about life in outer space (cosmic bodies, "empty space"). The survival of individual and the human community, but also the quality of life and happiness depends on the degree of the resilience.

To make everything goes according to plan, it is important to study the main measurement components of the index of resilience (IR):

- preparedness and preparation (to predict)
- mitigation measures (to resist, absorb, transform)
- the responsiveness (to answer, to modify)
- recovery mechanism (to recover, improve).

At the same time the measurement of IR is carried out for a variety of subsystems which are directly or indirectly related to quality of life and happiness.

Key subsystems that are essential for the survival and development of human communities in the cosmic environment and ensuring an adequate quality of life are:

- Radical changes of the environment (cruel living environment)
- Adaptation and transformation of a man to the new basic physical conditions (gravity, air-free space radiation, extreme temperatures...)
- Adaptation and transformation of man to new environmental conditions (harsh climate, the seasons, the absence of landscapes, variety of sounds / noises, different look of outer space...)
- Adaptation and transformation of biological systems to new physical and biological conditions (plants, animals, fungus, etc.) and the development of new biological systems
- Transport of people and goods to the destination (from the Earth to the selected celestial body)
- Creation and maintenance of permanent colonies in new habitats
- Sustainable development of human communities

- Development of new cosmic civilizations (the Moon, Mars, planets in other star systems and galaxies), etc.

Each of the above-mentioned subsystems require thorough research and the effective and efficient implementation of all four components of resilience, since only one unexpected event or human error can lead to catastrophic scenarios for human civilization(s).

## 5. CONCLUSION

By the end of this century there will be radical changes in all spheres of human life and those changes will be such that at this moment an ordinary man cannot even imagine them. They will completely change the current way of life. New knowledge and new technologies will open enormous possibilities for the development of human society. On the other hand, the organization of human community will be increasingly global, with full integration of communities at the local level. This process can be carried out as globalization (pure ideology) or as high ethical cosmic civilization. These are two opposite concepts, but the second concept is based on scientific settings, and globalism is an ideology like communism and capitalism. The outcomes of quality of life and happiness of the people are dramatically different for these two concepts of organization of human society.

However, the development of human society on the Earth is conditioned by several key processes:

- The rapid growth of human population
  - Global climate changes on the Earth
  - Excessive waste and exhaustion of natural resources (non-renewable, renewable) of the Earth.

These processes direct mankind toward:

- Sustainable development of human society on the surface of the Earth
- Migration of people into specific environmental conditions on the Earth (underwater, underground, ice and snow).
- Migration into space and colonization

of cosmic objects (asteroids, satellites, planets).

All three strategic orientations will experience the full realization in this and 22nd century, but they will achieve its full dynamic development in the 23rd century.

In accordance with the above, the dynamics of change in quality of life, well-being and happiness of people will also take place. Their dynamics will be dependent on the changes in the existing dimensions of quality of life, but also on the development of new dimensions related to new environmental conditions. These new dimensions are:

- Adaptation of the man as the biological system to the new conditions (Earth, space)
  - Adaptation of biological systems (necessary for man) to the new conditions and sustainable development of human society
  - Development of new cosmic civilizations
  - Resilience of quality of life in general.

Implementation of all four strategic directions of development of human communities will mainly take place in parallel with a relatively small time increments. On the other hand, each of these strategies is subject to uncertainties and unexpected events that can stop the growth or completely lead to a fatal end of the human community. To forestall this, the principles of resilience dimension must be observed with respect to its infrastructure and its key components:

- Preparedness and preparation (to predict)
  - Mitigation measures (to resist, absorb, transform)
  - The responsiveness (to answer, modify)
  - Recovery mechanism (to recover, improve).

So humanity faces great and fateful research challenges in this and the following centuries aimed at creating mature cosmic civilization(s) which should be characterized by a high quality of life, well-being and happiness of every person and of every human community as a whole.

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