SOCIETY ON MARS BASED ON EXAMPLE OF IDEACITY PROJECT

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ABSTRACT

Mars is the natural direction of space expansion. It is a trend that we consider Mars as not only a planet where we want to take the first step, but a place where we could live in the future. This would be another step for humanity, which would help us to become an interplanetary species. However, it is necessary to carefully prepare such an ambitious plan. Establishing a permanent settlement on Mars is not only a huge technological challenge, but also an organizational problem, and its solution is crucial to the implementation of such plans. Thinking about the Red Planet as a future place of residence, a lot of social, political and economic issues should be considered. In our presentation we will present i.e. various models of managing such a settlement and economical aspects as well as cultural and social issues related to work, education and development or ways to spend free time. We will present an optimal model of functioning such a settlement, taking into account mentioned issues, on the example of the Mars settlement project for 1000 inhabitants, designed for the Mars Colony Prize competition.

KEY WORDS

Mars, Mars base, Mars exploration, Society

INTRODUCTION

Nowadays, more and more is heard about Mars as a potential place to live in the future. And no wonder the planet surrounding us is the friendliest place to live as we are used to on Earth. This does not mean, however, that creating the right conditions for Mars on Mars will be easy. For the Mars Colony Prize, organized by The Mars Society, our team designed the Martian city of Ideacity, which won 5th place in the final of the competition, which took place during The Mars Society Convention in Los Angeles in 2019. Our task was to create a base for 1000

residents, and among the scoring elements was not only design, but also the system and organization in the base, social issues or economics, and this was the basis for our reflection on Martian society. The following document presents society on Mars when it reached 1,000 inhabitants in a Martian base.

HOW SOCIETY ON MARS SHOULD LOOK LIKE?

Supporters of Mars exploration are guided by various motives. Some of them believe that a huge contribution to science is worth such an undertaking. Others see it as a mission to make humans an interplanetary species. Some consider Mars to be a rescue if something bad happens to Earth. For others, this is an opportunity to fresh start and avoid the mistakes we made on Earth. There are also those who consider settling Mars as a unnecessary idea.

Let's think about what life would be like on Mars, however, if we decided to implement the idea of settling Mars. First, we must take into account the fact that life on Mars will look different. Why? We have to reckon with conditions that do not make it easier for us to settle in Mars. Radiation, low temperatures, over 100 times lower pressure - these are just a few problems [1]. Also consider the distance from Earth and the isolation that comes with it - due to the small size of the base and the fact that future residents will be on their own, since all rescue missions will last for months. If we want to consider Mars not as the destination of one of the missions, but rather the future residence of people, we must consider many more aspects.

Should the presence of man on Mars be short-term mission or permanent residency, and what does it involve - will the stay on Mars be a business trip to expand the base or maybe we treat him like a home? Should we pay the person flying there, as they will work there to develop the base, or should they pay for the opportunity to move and live there? Are we treating Mars as a huge mine, from which we acquire resources that are missing on Earth or is this our second home, and we manage resources in a sustainable way to prevent them from running out in the future?

Our project was created for the needs of the competition, which involved designing a base for 1000 people. In our opinion, 1000 people are the moment when life on Mars is already life-long and Mars is our home. That is why we have considered many issues in our considerations. First, you had to think about organization in the base.

We should focus on relations between Earth and Mars. Does our settlement belong to someone? It is owned by some countries that build them? We do not think that we should own Mars. So maybe it is an independence place? But it demands lots of money. Why someone or some institution should pay for that if it will not belong to them?

How should we decided about it? And who should do it? How should Mars law be like? How our organization look like? Do we have our own government on Mars? So it depends on answers for questions we asked before? Maybe it is controlled by the Earth? But it does not seem to be a good idea. Mars is dangerous, so we need to have possibilities to decide quickly. We should also have some long-term strategy for Mars. We can not change our mind in every few years, it can destroy all our affords. How the daily decisions look like? Do we have democracy? Do our residents have possibility to decide? Or it is too dangerous to let them do it? How to find a balance between safety and freedom?

And what about economy. It is an expensive project. Who should pay for it? How to find money that? For building and maintaining this settlement? And what about our self-sufficient. If we achieve this level when we are self-sufficient, how should it look like? Do we have money? Do we have trade with Earth? Do we earn, gather resources, do we have salaries on Mars? Do we need to pay for Staff or all things we need are given to us? We should focus on relations between Earth and Mars. Does our settlement belong to someone? It is owned by some countries that build them? We do not think that we should own Mars. So maybe it is an independence place? But it demands lots of money. Why someone or some institution should pay for that if it will not belong to them?

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There will be people in such a settlement. Lots of them. What will they do? How they work? Do we pay them, or they pay us to live there? Do we have money, so they can buy things, or we ensure them everything?

And what about education? Do we hire a specialist from Earth? Or at this point we have our own specialist and education system do we create a new specialist on our own. And how to ensure optimal teaching standard? Should we realize it in digital way, or we need contact with other person so it should be done in standard way. Do we try to have more individual approach, or we do not have time or resources for that? We have only 1000 people.

And how our specialist look like? Does he or she has specialization or maybe we should be more interdisciplinary to deal with complicated problems on Mars. If we have only 1000 people, we can not have every possible specialist. Or maybe we have some kind of cooperation with Earth?

And what about our people. Do they have this freedom to choose? To change they work? Or maybe it is too dangerous for our settlement, so they can not. Because what if our all doctors decide to be programmers. Who will take care about residents health for example?

Work and education are not everything. If we need to spend there our whole life, we need something more. We need to have interests, to realize ourselves, to spend free time, to create. So how to ensure wide choice? We can not build and maintain all of cultural things – theater, museums, opera and more. For sure, we can use new technologies for that, but will it be the same? Is it enough?

So what about hobbies? There is so much possibilities on Earth. How Mars could be better if we will not have them all? What about sports? Individual sports or fitness is quite easy to do – we need to work out for our health, but what about team sports? We have only 1000 people. What about other activities. It is not difficult to ensure place for yoga, Staff for crafting, place

for cooking or library, but… Do we need it all? It is a small settlement. Should we waste our resources to ensure it all? What if only one person would like to do something?

Should we help her to realize her passion? It is wasting of our time and resources, but on the other hand – do we really want everyone to be the same, making the same things? We need creativity to be efficient on Mars.

Is tourism possible? Can we rest during our holidays for example on Earth or should we create something on Mars. And what about more dangerous activities. Some people need to feel adrenaline. Will Mars looks like the Earth? Will there be restaurants, bars, shopping malls or beauty services? It sounds stupid but if we imagine that we live there our whole life, probably underground, isolated – then it seems to be more needed for our mental health.

Of course, all the aspects under consideration relate to the future, but when planning our presence there, it is worth considering now how our presence on Mars should look like, because of this we are able to better plan the missions, which will be more effective, faster and cheaper in the long-term approach. Our considerations allowed us to conclude that 1000 inhabitants is no longer just a temporary base for a group of astronauts, but a Martian city operating as an efficient organism, composed of many aspects. To function properly, it must be designed in such a way as to meet the needs of people living in it. Hence, social issues were the first element we had to develop to design a settlement for 1,000 inhabitants on Mars.

SURVEY

So that the base we design reflects not only our approach, but also takes into account the needs of a wider group, we conducted a survey of 167 people of different ages and from different environments, asking them about various aspects of potential life on Mars - from the system, through activities to the appearance of apartments. Our goal was not to get one answer, but to learn different points of view. That is why we gave the respondents a wide spectrum of answers so that they could express their opinions on many topics in the best way possible.

Organization

An important issue at the Martian settlement for 1,000 people is the organization of such a settlement. We asked respondents about how such a base should be managed, and the results are presented in Figure 1. As you can see, the answers to the question "Who should the base belong to" were ambiguous. The answers were divided more or less equally between 4 answers from other countries - the base should belong to the founders, the base should belong to a specially appointed unit on Earth, the settlement should be owned by its inhabitants and function as a separate state and the base should be international and every country on Earth should have equal access to it. Given that this is an important issue in the context of manned flights to Mars and possible housing on this planet, there is a huge need to find a common solution. This will avoid future problems and determine the direction and nature of our presence as humanity on Mars.

MARS COLONY
Government and organization

The best way to govern the colony

- Other 3%
- Absolut power 8%
- Democracy 13%
- Hybrid 43%
- Council 27%

The owner of Mars base

- Others 1%
- Independent country 20%
- Institution on Earth 31%
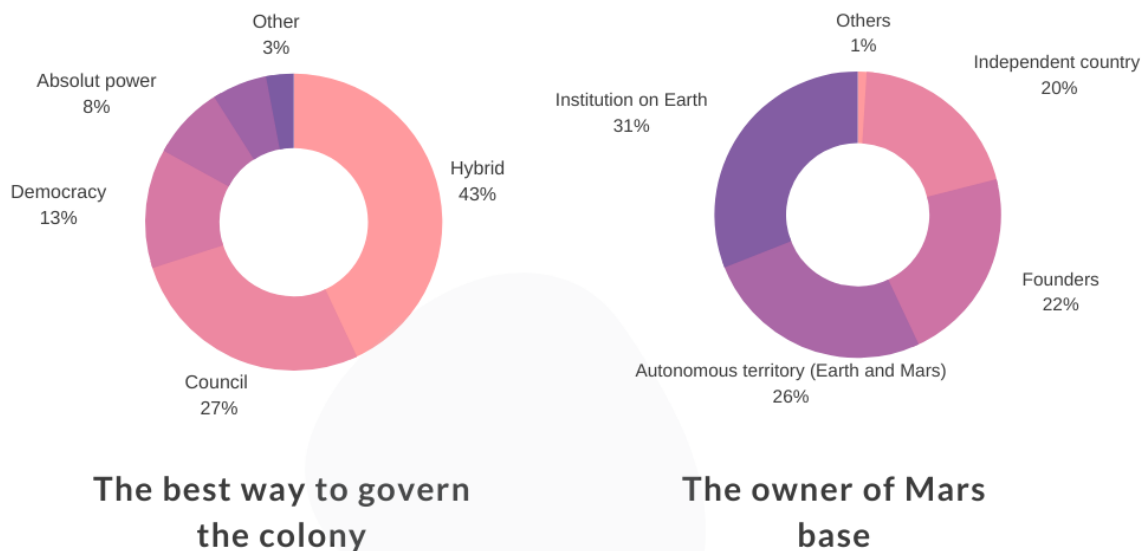- Founders 22%
- Autonomous territory (Earth and Mars) 26%

Figure 1. Government and organization – answers in our survey

The next question was to determine the expected system in the base. The respondents were asked to mark the issue which, in their opinion, best reflects the best way to manage the base from a number of different sentences describing various possible systems. Most people, 49 said that tactical decisions on basic aspects related to experience (water, energy, industry) are made by a suitably experienced and educated Council, while decisions related to daily functioning (education, entertainment, leisure, housing) are taken by a majority of votes. Slightly less, because 46 people were inclined to technocracy and thought that when governing a settlement, huge knowledge related to various aspects is important and decisions should be made by people with relevant experience. The next two responses were received in turn by democracy (22 votes) and weighted votes, in which decisions are taken by majority vote, however the voice of specialists in a given field has more weight (20 votes). Only 11 people were in favor of exclusive remote authority from Earth.

We also asked a direct question about who should rule the base. Here, the responses already strongly indicated a certain independence of the inhabitants of Mars in base management - only 7% of the responses pointed to the need for exclusive power remotely from Earth, by the institution / company / founding countries. However, as for the system prevailing in the base, we have not received a definite answer. Again, the answers were evenly distributed between democracy, a hybrid model, assuming the cooperation of the inhabitants of Mars with representatives of the Earth and the authoritarian system. One can see that organization and management in Martian conditions is not so obvious. On the one hand, living on Mars we would like to have an impact on our lives. However, taking into account the huge risk

associated with wrong decisions, they should not be surprised by the answers that propose an authoritarian system and want to hand decision-making into the hands of one, the most experienced person or even hand over some of the decision-making to specialists working remotely from Earth.

Economy

Economics is another issue we examine. We asked respondents to select 5 sentences, which in their opinion best illustrate the ideal situation on Mars in this matter. The 3 most-frequent answers collected 70 votes each and were: the necessity to introduce a duty to work on Mars, equality of all people, because every type of work done on Mars is just as necessary to maintain our base and to indicate cash circulation as an unnecessary element, because on Mars everyone basic needs should be provided, and the remaining resources should be used to develop the base. It can be seen that the respondents believe that 1,000 people is not yet the time to introduce a free market economy, but it is a stage in which one should focus on further development in order to achieve self-sufficiency. At the same time, another answer (63 votes) indicates that our relationship with the Earth should be of a partnership nature, and we should trade with it instead of being kept by it or giving away raw materials. In this context, it is not surprising to introduce a duty to work or to manage resources wisely, as this will help to become independent of the Earth. Interestingly, the next three responses, which collected more than 50 votes, indicate that the system of work on Mars should be similar to Earth, stay on Mars should be short-term, and Earth should maintain a settlement. So you can see that many respondents believe that 1,000 inhabitants is not yet a stage where the base is independent and functions as an independent unit, but rather is still being developed by the Earth in the form of short missions. The distribution of the remaining answers is shown in Figure 2.
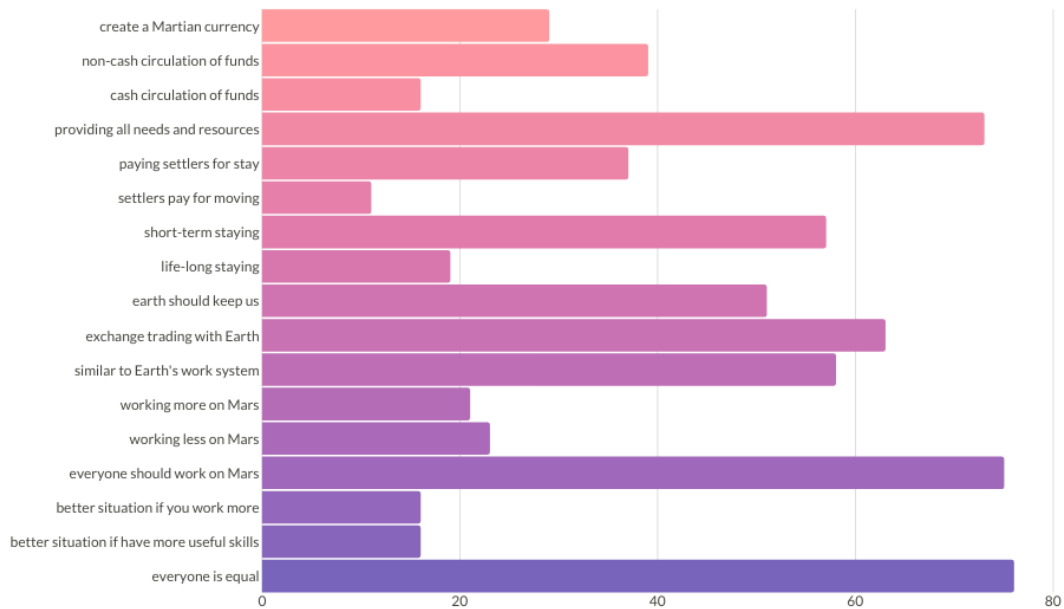
ECONOMY

Figure 2. Economy on Mars

1000 people are still too small to provide all the fields of science necessary on Mars, and even more so take care of other issues. Therefore, on Mars, we will have to use new technologies in education, culture or entertainment. After all, most respondents do not want to give up contact with another person and would like the services to be carried out in a traditional way by other people, as shown in Figure 3. Over 30% of people think that new technologies should be used, such as VR, AR, robots and all simulations to ensure the widest possible spectrum of activity. ¼ people are willing to adopt any model. Only 3 people would be willing to watch broadcasts from Earth (e.g., cultural events). So you can see the great importance of the further development of technologies that will allow us to faithfully simulate some activities, but complete replacement of man seems impossible and unlikely.

SERVICES
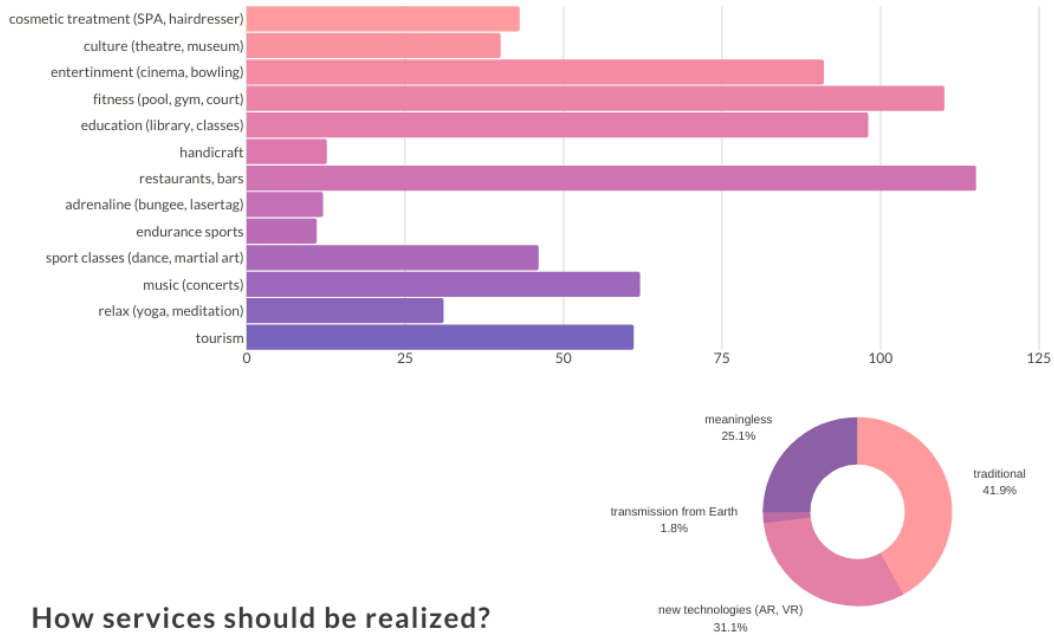
Survey - Ideacity 2019

Figure 3. Services on Mars

Due to the fact that not all things can be reproduced on Mars, and the simulation may be insufficient, we decided to examine what activities would be most needed by future residents, as shown in Figure 3. The first 3 places were bars and restaurants, fitness (gym, playgrounds, fitness classes) and additional education (library, organized classes, access to online courses, etc.). The fourth one was entertainment, understood as standard activities - cinema or bowling. On Mars there would also be important music (also in the form of concerts and festivals), tourism (associated with visiting Mars) or cosmetic treatment (such as SPA or hairdresser). Slightly lower are other sports activities, such as martial arts, dancing, adrenaline-related activities (laser tag, go-karts, bungee) or at the penultimate place unusual sports (climbing, squash, etc.). Less popular were cultural (opera, theater, philharmonic) and relaxation (like yoga and meditation) activities. On the penultimate place were all the hand-made works (painting, sculpting, etc.).

We also asked respondents about housing issues, as shown in Figure 4. The vast majority of people show an understanding of Martian conditions and related disadvantages. Over 50% would not have a problem with living in several-person rooms on Mars. Slightly over 25% categorically would like to have their own room, because privacy is crucial for them, and the rest is not sure. On the other hand, with bathrooms almost 72% of people would have no problem sharing a bathroom, and only 11.4% categorically would like to have their own bathroom in their apartment on Mars. Over 50% of people indicated a computer and a wardrobe as the obligatory equipment of their room. Answers such as: desk, music player,

armchair, chair, kitchenette and mirror were indicated by over 25% of people. The least votes were given to shelves, a TV set, appliances such as a washer and dryer, a table or a radio.
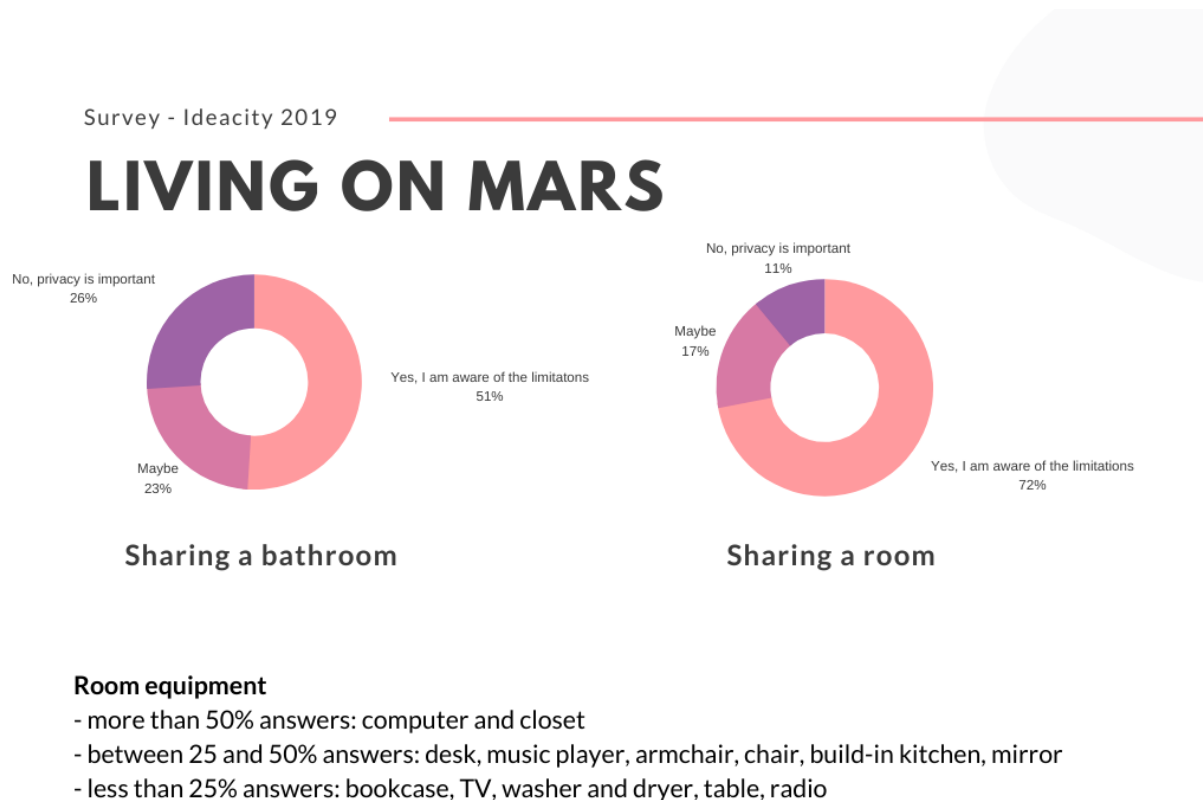

Survey - Ideacity 2019

LIVING ON MARS

No, privacy is important
26%

Maybe
23%

Yes, I am aware of the limitatons
51%

Sharing a bathroom

No, privacy is important
11%

Maybe
17%

Yes, I am aware of the limitations
72%

Sharing a room

Room equipment
- more than 50% answers: computer and closet
- between 25 and 50% answers: desk, music player, armchair, chair, build-in kitchen, mirror
- less than 25% answers: bookcase, TV, washer and dryer, table, radio

Figure 4. Living on Mars

In such an isolated environment (Fig. 5), knowing the restrictions that await us on Mars, only slightly more than 30% of people categorically would like to have an animal, such as a dog or a cat, on Mars. When asked about the expected interior design, the voices were more or less equally divided between classic and futuristic interior design. As the most important elements of the decor, respondents indicated live plants, adequate lighting, access to natural light and spacious interiors. The results should not come as a surprise, as the positive effects of plants and natural light on our mental health are known. Further on, there are elements such as accessories, designer furniture, various surface textures, known scents and colorful walls. The least important, but also futuristic shapes, non-standard shapes of areas, art, fashion trends and various interior decor.
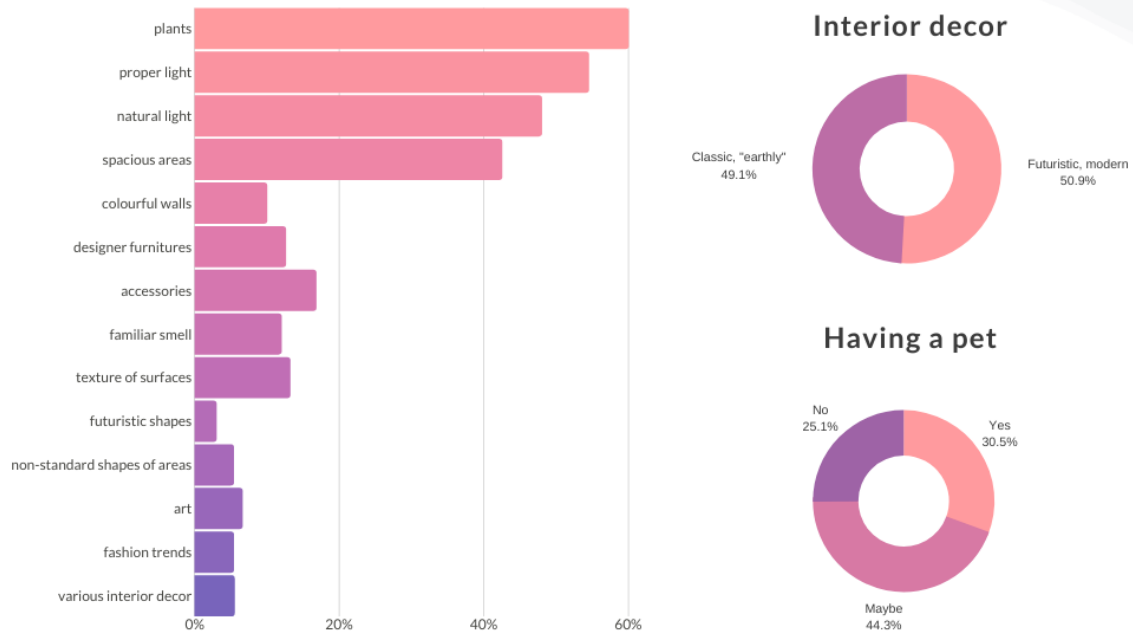
Figure 5. Aesthetic

The answers of the respondents in many places were not unequivocal, which indicates that, thinking about living on Mars, we need a public debate on what it should look like and working out one front together. However, the point at which the base reaches 1,000 inhabitants is also a breakthrough point. At this stage of development, we are already achieving some independence from the Earth, but this is still not our final point at which we are completely self-sufficient and this discrepancy can be seen in the responses of the respondents, who on the one hand consider most residents as decision-makers, on the other hand they see the necessity introducing rules that limit their freedom in the name of security. And this is not surprising, considering the great risk of living on Mars, if any. However, we should strive to achieve self-sufficiency and independence as soon as possible, and thus direct the rules prevailing in the base towards full democracy and free market economy, but the stage of 1000 inhabitants is not the moment, although a strong turn in this direction is already visible.

Although people are aware of the fact that life on Mars will look different and are able to make concessions, some needs remain unchanged. To maintain mental health, we cannot ignore the issue of access to natural light, the need for contact with other people, not just technology, and taking care of higher-level needs, providing a wide spectrum of available activities and designing interiors accordingly.

OUR CONCEPT

Given the results obtained, we proposed our own solution for the future Martian society. The system proposed by us is based on technocracy. Such a venture involves a lot of risk and our decisions can have serious consequences. Therefore, important decisions related to the functioning of the settlement should be taken by the Council (Fig. 6). 1000 people are still not many, so the Council should not be too extensive. We proposed a division into an 8-person Council and 4 departments, also consisting of 8 people, who bring together the most important issues - the industry department, which is responsible for production, energy management, automation and data management. Another is the environment department, which takes care of resources management, agriculture, life support systems and waste management. The third is the development department responsible for R&D, medicine, city planning and architecture, and transport planning. The last one is the internal affairs department, whose competences include politics, law and judiciary, finance, social affairs or culture, sport and tourism. The board should, however, perform an executive function, and its members should be specialists in one of the fields within the department. A small group of people is not able to know each area, which is why we believe that individual problems should be solved in interdisciplinary teams that develop the best solution for a given problem.

In this way, we will involve all residents in the management of the settlement, and on the other hand, we will secure decisions based on knowledge and experience. Management should be data-based and use AI. To ensure that members of the Council and departments perform their functions properly, members should present their plan before the election, and should be subject to a vote of confidence twice during their term of office. In such a small and highly automated base, we are able to ensure the flow of information in real time, therefore, although decisions are made by a small group, all information should be public and easily accessible, and short, general voting among all residents conducted at each major decision to know them sentence. Management should be based on data on the one hand, and trust and relationships on the other.

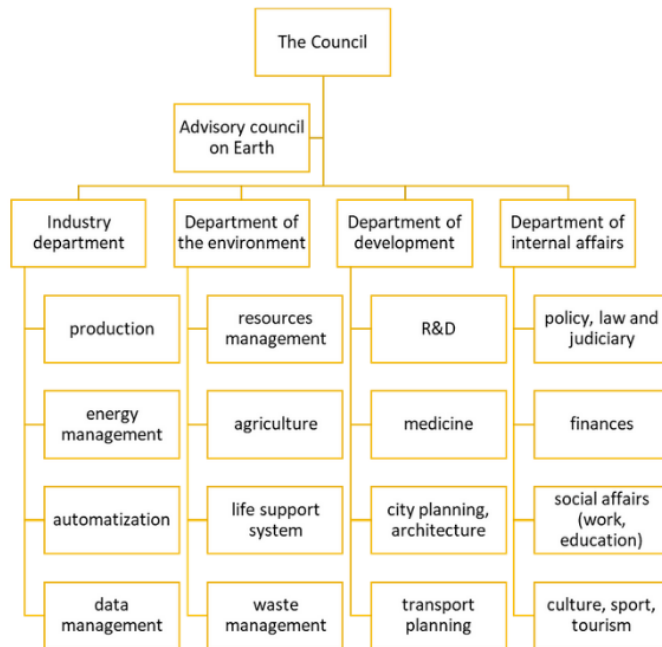# GOVERNMENT AND ORGANIZATION

Figure 6. Council

The Earth should only have an advisory role. We believe that this is the right way to manage such a settlement, at the same time, we believe that with the increase in self-sufficiency and independence from Earth, as well as getting to know Mars better and adapt to the conditions there, we should strive for democracy.

Our base should act as an advanced research center, because we must adapt all terrestrial technologies to Martian conditions. This creates the opportunity to build a large portfolio of intellectual property. Therefore, we believe that IP should be our main export good. The transport of raw materials or elements produced on Mars is unprofitable or difficult due to the cost and duration of transport between Mars and Earth, and the limited resources mean that we should reasonably manage them and use settlement on Mars for development, and not transport them for Earth. In addition, IP is much more valuable and will allow us to become financially faster from Earth. At this point (1,000 inhabitants) Mars should be a partner for Earth, and the exchange of goods should be carried out on market terms. The activity of the Martian base as an advanced research center is also helped by the fact that such a settlement must be highly automated. With 1,000 people and so much scientific work to do, we should treat our residents as specialists and use them for tasks that the robot will not do. Therefore, the automation of most processes is key to base development. In addition, acting on this principle requires that we place an emphasis on education throughout life, and in the case of generations born on Mars - learning through practice and access to current knowledge, because on Mars the state of knowledge will develop very dynamically.

We believe that there is no need for cash circulation at Mars at this stage. All residents should be provided with housing, food and other basic needs. According to our gradual model of population growth on Mars, when we reach 1,000 people, living on Mars is already life-long living there. Our goal is to create a society on Mars, not to send a group of astronauts there on short-term missions. The main source of income is intellectual property and commissioned research. However, diversification of revenues is very important, and creating an economy based on one branch irresponsible, so the base should also earn on other things. Due to the fact that space mining in the form of obtaining resources from asteroids would be easier to implement from Mars than from Earth, sales rare raw materials could be an additional source of income. In addition, terrestrial tourists and academics exchanges and the sale of other goods would have little income - gadgets or valuable items like art. From Earth, we would have to import advanced electronics, software licenses or all other items that cannot be made on Mars due to conditions, uneconomical due to small scale or unprofitable due to the need for advanced infrastructure.

New technologies can not replace interaction with other people. Creating society is a process that occurs spontaneously. We should only create proper conditions. Therefore, our idea of housing is cohousing, i.e. an intentional space where people know each other and interact with each other (Fig. 7). People have their own place, but also share significant spaces, such as kitchen, dining room or living room. People live in modules of 100 people and have their own rooms of 15-25 m^2, which thanks to flexible modules can be connected to create a bigger apartment for example for family. The modules have different configurations and designs.
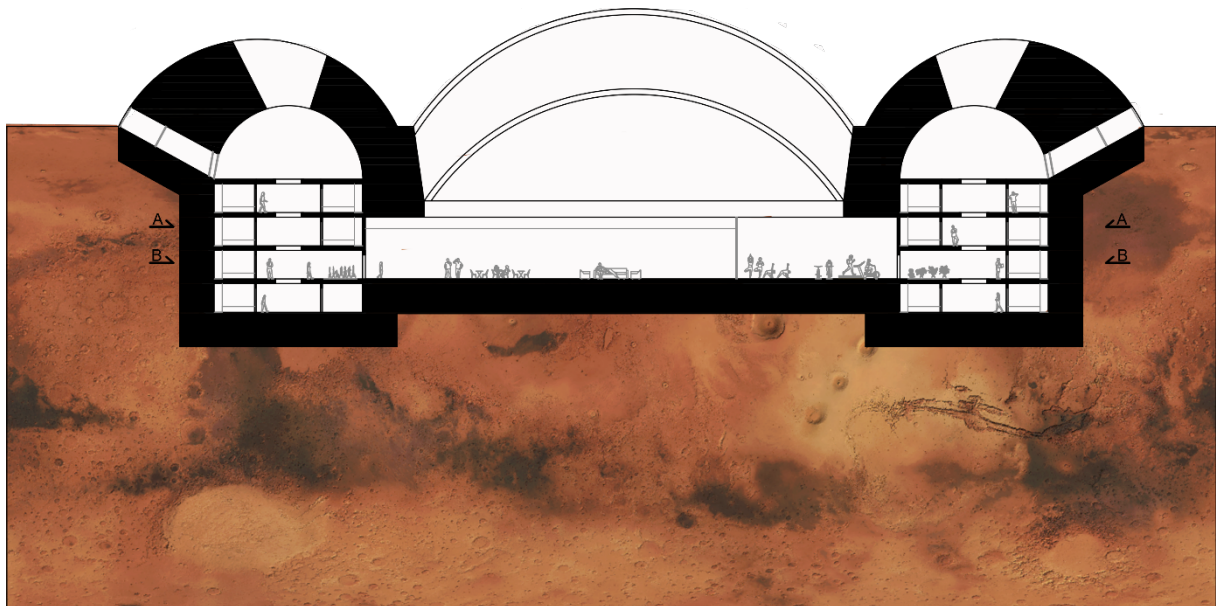

Figure 7. Living area

We also took care of aesthetics as an important element for mental health. Living plants, spacious, varied in interior design, color psychology or various textures of materials are very important. Access to natural light is provided by the transport system of concentrated sunlight via fiber to the emitters inside. Details about the architecture of our base can be found in the publication "Architecture on Mars based on example of Ideacity project".

Work in the base is focused on development and more creative than monotonous. Specialists living on Mars should be interdisciplinary, because the development of the base requires many specialties that 1000 people will not cover, as well as focused on continuous development. Adaptation of Earth's technologies to Mars will require continuous work and self-development. If we can solve the problem of giving birth to children, then we need to ensure an adequate education system on Mars. An individual approach will be important, and constantly changing knowledge and new discoveries require continuous self-development. Education on Mars will not be possible without the use of digital education in case of standard classes, but advances knowledge should be taught in practice, as the preparation of learning materials is time-consuming and unprofitable for a small group of people, and the emphasis on interdisciplinarity requires orientating in many areas.

Mental health will be important in such isolated space as our Mars base. That is why we took care of ensuring the widest possible spectrum of available activities, as shown in Fig. 8. In the center of the base is the center of life, in which we placed most of the functions - food, library, museums and rooms for other cultural activities, various additional activities or for example beauty services . It is a place where people can meet and spend interesting free time. We have created a sport center in which they find playgrounds for various disciplines - both team and individual as well as a fitness center. Nearby there is a school where not only possible young generations learn, but also all residents can develop their interests and deepen knowledge in various fields. There are rooms for self-study and well-equipped laboratories and classrooms in various fields. Classes are organized, but residents can also organize themselves and learn from each other. We have two houses of religion that are used to calm down. You can both practice your religion and simply meditate in silence. Although we try to use plants in every place, we have also created two large parks that allow you to spend time in nature.

An interesting idea is a hotel where, on the one hand, a VR travel agency operates, and on the other is a starting point for all tourist trips around Mars. The hotel has a much higher standard than the rest of the base to provide tourists with the conditions they are used to on Earth and give our residents a place where they can have a real vacation and rest from work. There is a huge swimming pool with a beach, simulations of different landscapes and places, significant areas with exotic plants and non-standard entertainment, such as a laser tag and a water amusement park or a high climbing wall. The hotel also changes its decor every year to provide residents with different forms of relaxation each year. In addition, there are all things that allow you to spend your vacation without leaving it - restaurants, a cinema, bowling alley, SPA or concert hall and artistic studio.
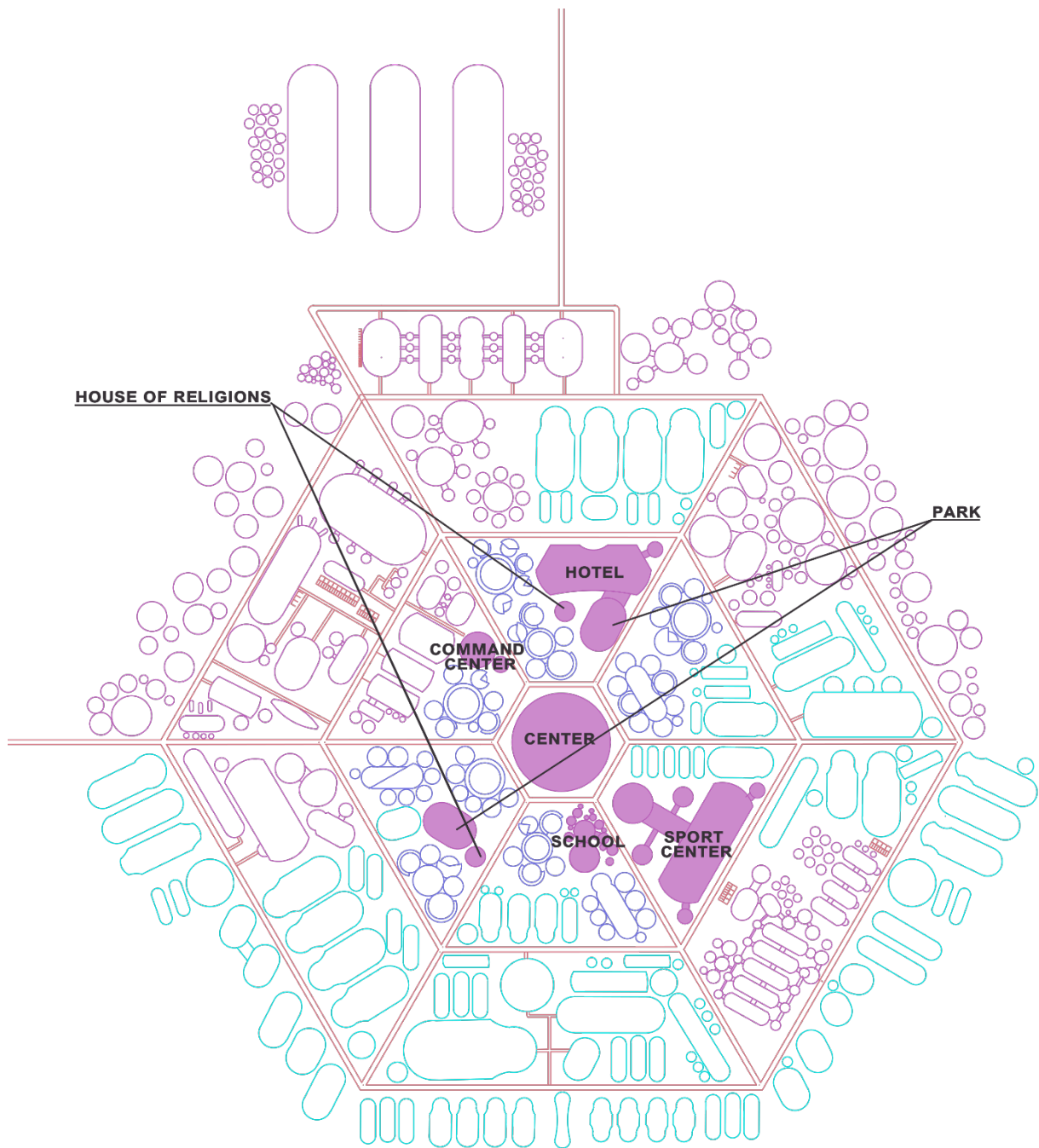
Figure 8. Activities

OUR PROJECT IDEACITY

Our project taking into account the Martian conditions and needs of the inhabitants looks like Figure 9.
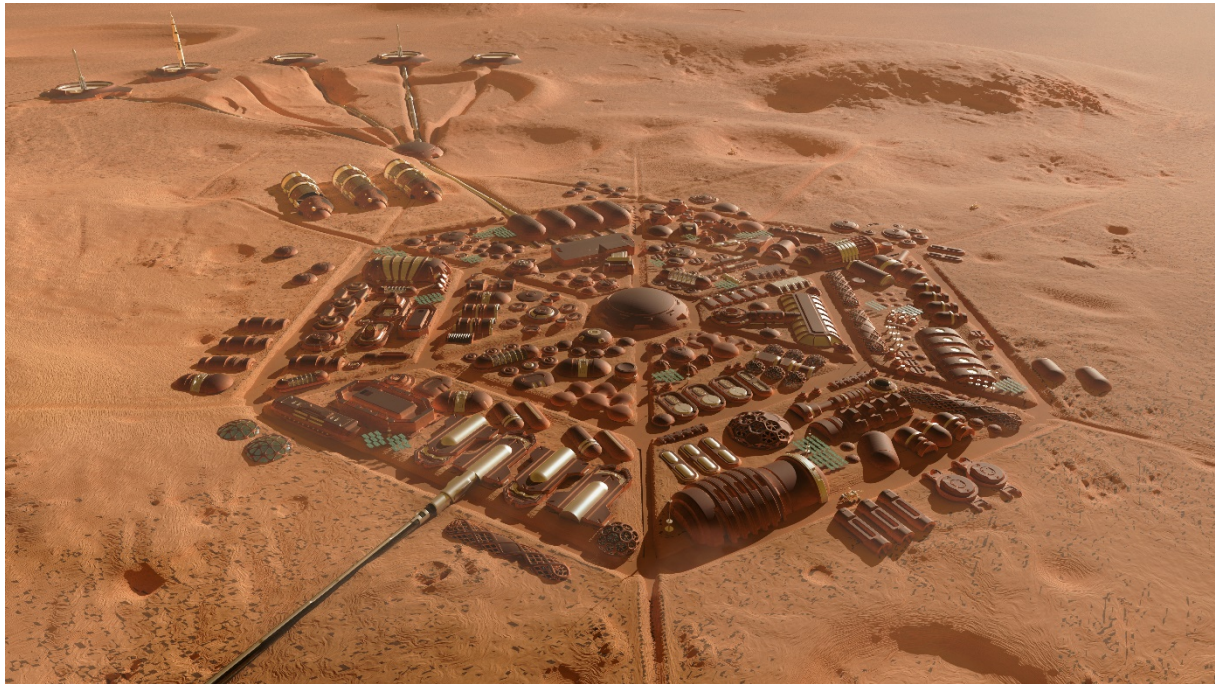
Figure 9. Ideacity

It is located underground and has hexagonal shape. We designed the whole city which has more than 100 buildings that we think are needed to be self-sufficient. Division of the base into many small buildings separated by locks is an additional protection in the event of an accident and will reduce losses. The base is highly automated, thanks to which we can achieve a high level of self-sufficiency. We took care of the redundancy of most solutions to ensure security.

We were inspired by Renaissance concept of ideal city – that is the reason why our settlement is called Ideacity (Fig. 10). Ideal city should have short distances, so our city is located on hexagonal shape which has side about 400 meters. Transport of people is underground, and they are walking by foot for their condition and health and to avoid radiation. In the center we have big building with common services. Residential area is located around. Our industrial area and all agriculture buildings are located closer to the outer part. You can read more about the in our paper „Space industry based on example of Ideacity project". We decided that if we want to live on Mars we should make this life as good as it is possible, that is why we located in our city a lot of common places. You can find there sport center, school, lots of parks, even house of religion. All services are realized in this big building in the center. We even took care about holidays, so we have a hotel where are firstly guest from Earth (scientists), secondly – our own residents.
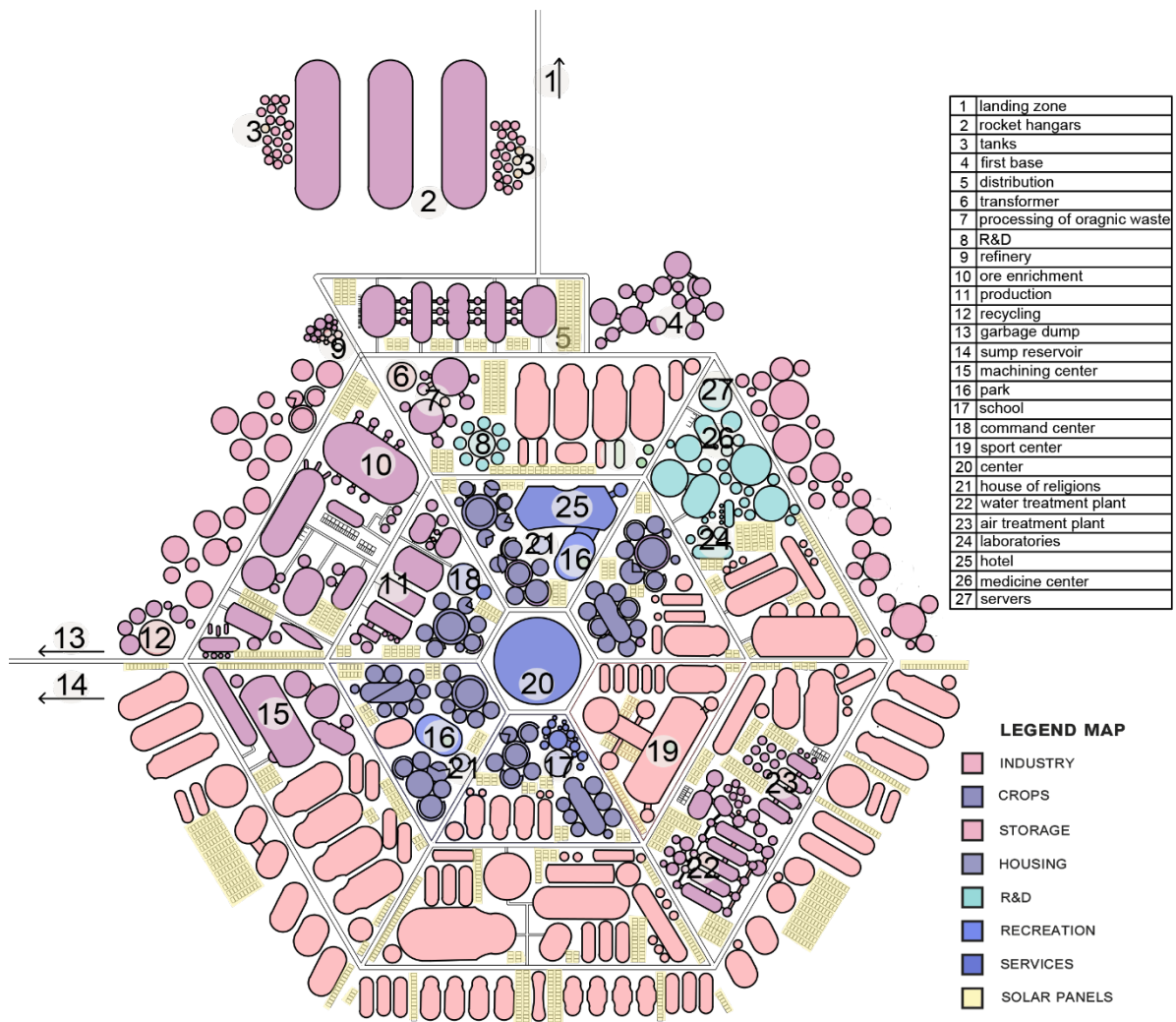
Figure 10. Functional analysis of Ideacity

SUMMARY

All assumptions allowed us to design a city that will operate efficiently and properly fulfill its functions. Life on Mars will be different from that on Earth, but other does not necessarily mean worse. We can not forget that technology is not everything. Social issues are as much important as technology ones. Our safety depends also on proper economy, system and law, which will ensure safety and justice. If we design our future Mars city properly, we can achieve it faster, cheaper and easier. New technologies can not replace interaction with other people. Creating society is a process that occurs spontaneously and we should take care of proper conditions for that. We need to remember that we can predict exactly how Mars society will look like, but we can create conditions where all processes connected with creating a society can run properly.

The system proposed by us is based on technocracy. We believe that there is no need for cash circulation at Mars and all residents should be provided with housing, food and other basic needs. According to our gradual model of population growth on Mars, when we reach 1,000 people, living on Mars is already life-long living there. Our goal is to create a society on Mars, not to send a group of astronauts there on short-term missions. The main source of income is intellectual property and commissioned research. We need to took care of mental

health. Living plants, spacious, varied in interior design, access to natural light, color psychology or various textures of materials are very important.

REFERENCES

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