
EPIC
CHALLENGE JNS

Requirement	Importance	Reference: Symbology and Satellites+Simulation for same situations+2D barcode Alphanumeric+Robot Crane+Chemicals,germicides	Concept 1: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides	Concept 2: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment	Concept 3: Symbology Satellite+Phone Call+2D Camera to sense parts+3d-printing+Boiling
1.Shall assist astronauts to repair robotic surgery equipment	3		+1	+1	+1
2.Shall allow experts on Earth who are not physically in the same space to collaborate and develop instructions for astronauts	2		0	+1	0
3.Shall minimize a chance of incorrect assembly	2		+1	+1	0
4.Shall minimize total time required to fix the medical equipment	1		-1	0	-1
5.Shall disinfect the fixed medical equipment at the level required for surgeries	2		0	+1	-1
6.Shall work on Mars	3		0	+1	0
7.Shall have high robustness	1		+1	0	0
8.Shall have high redundancy	1		+1	0	+1
TOTAL		0	6	10	1

Evaluation Table

Team 1

1st REQ: Shall assist astronauts to repair robotic surgery equipment

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+1 Score.**
- Based on personal estimation the 360° cameras allow experts to have a look at everything that is going on and lets them assist the astronauts during the process effortlessly. Using optical satellites increases the bandwidth which enables the usage.

Evaluation Table

Team 1

4th REQ: Shall minimize total time required to fix the medical equipment

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **-1 Score.**
- Based on personal estimation the process of printing all the parts with a 3D-printer takes much more time than using stored parts brought to Mars in advance - in medical emergencies every minute counts so there is no time to wait for the printer.

Evaluation Table

Team 1

2nd REQ: Shall allow experts on Earth who are not physically in the same space to collaborate and develop instructions for astronauts

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **0 Score.**
- Based on test data compression, using Huffman algorithm makes transmission as fast as with the reference idea.

Evaluation Table

Team 1

5th REQ: Shall disinfect the fixed medical equipment at the level required for surgery

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **0 Score.**
- The concepts idea and the reference idea are the same.

Evaluation Table

Team 1

3rd REQ: Shall minimize a chance of incorrect assembly

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+1 Score.**
- Based on the personal estimation the 360° 3D cameras and 3D tools decreases chance of incorrect assembly because astronauts can have deeper understanding about the problem with different angles.

Evaluation Table

Team 1

6th REQ: Shall work on Mars

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+0 Score.**
- Based on personal estimation the both concepts are designed for Mars so it is the main idea that they need to work on Mars properly.

Evaluation Table

Team 1

7th REQ: Shall have high robustness

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+1 Score.**
- 3d printing parts and tools have very high durability and different tests (1,2) show that they can easily replace parts that are usually made out of other materials. In addition it is easy to produce many parts on location if more are needed.

Evaluation Table

Team 1

8th REQ: Shall have high redundancy

1st CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+1 Score.**
- Based on expert estimation, It is important that to bring what you need considering about every pound is worth 10K$ even more for Mars. In this matter, It is to bring just raw material and convert to useful tools and parts. Also, It is good to recycle the tool and make another tool for its purpose. Therefore, 3D printing provides high level redundancy for Mars exploration.

Evaluation Table

Team 1

1st REQ: Shall assist astronauts to repair robotic surgery equipment

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **+1 Score.**
- Based on on our personal estimation, astronauts have a better estimation – with additional help through the VR-instructions from earth – to repair the robotic system and can react in a more flexible way than a machine.

Evaluation Table

Team 1

4th REQ: Shall minimize total time required to fix the medical equipment

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **0 Score.**
- Based on the fact that video communication takes longer than the given reference idea (symbology and satellites), but at the same time contains more information. So one positive aspect and one negative aspect lead to our "0": Information link.

Evaluation Table

Team 1

2nd REQ: Shall allow experts on Earth who are not physically in the same space to collaborate and develop instructions for astronauts

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **+1 Score.**
- Based on our evaluation of the first requirement, we think that the constant contact to earths experts through VR leads definitely to a better collaboration for solving the problem.

Evaluation Table

Team 1

5th REQ: Shall disinfect the fixed medical equipment at the level required for surgery

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **+1 Score.**
- Based on the fact that bacteria can´t multiply themselves at a temperature below -18 degrees (average temperature on Mars is -55), it is faster, simpler and cheaper to disinfect the surgery system by just putting the medical equipment outside on the Mars.

Evaluation Table

Team 1

3rd REQ: Shall minimize a chance of incorrect assembly

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **+1 Score.**
- Based on tests and practices on earth with simulated mars environment and circumstances, the chance of an incorrect assembly will be minimized.

Evaluation Table

Team 1

6th REQ: Shall work on Mars

2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **+1 Score.**
- Based on the fact that both – our concept and the reference idea – work on Mars, our concept requires less resources and would probably work faster than the reference idea.

Evaluation Table

Team 1

7th REQ: Shall have high robustness
2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **0 Score.**
- Based on the fact that the robotic system got tested in both concepts on earth with simulated Mars environment, both systems will withstand the circumstances on Mars.

Evaluation Table

Team 1

8th REQ: Shall have high redundancy
2nd CONCEPT: Video+Simulation for same situation+2d barcode alphanumeric+Xr/Vr instructions+Mars Environment

- **0 Score.**
- Based on the fact that our concept has no superior solution to improve redundancy, we evaluated our concept equal to the reference idea. Furthermore, we don´t have a 3D-printer which plays a vital role on Mars (printing food, medicine, tools, …)

Evaluation Table

Team 1

1st REQ: Shall assist astronauts to repair robotic surgery equipment

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **+1 Score.**
- **By personal estimation as the component ideas are each designed to be better than the original, and have then been improved on to further eliminate flaws, and we therefore feel that this is better at this requirement.**

Evaluation Table

Team 1

2nd REQ: Shall allow experts on Earth who are not physically in the same space to collaborate and develop instructions for astronauts

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **0 Score.**
- **By personal estimation this is very similar to the reference method and does not offer a significant advantage.**

Evaluation Table

Team 1

3rd REQ: Shall minimize a chance of incorrect assembly

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **0 Score.**
- **By literature sources, the 2d camera may be less reliable than humans at identifying parts. However, the printer allows for having only the correct parts and tools available, and current printers can give sub 100 micrometer accuracy.**

Evaluation Table

Team 1

4th REQ: Shall minimize total time required to fix the medical equipment

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **-1 Score.**
- **By personal estimation this process will take more time largely because the use of the 3d printer will take more time. Also using the camera to identify parts will likely take longer than a human.**

Evaluation Table

Team 1

5th REQ: Shall disinfect the fixed medical equipment at the level required for surgery

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **-1 Score.**
- **By literature sources it is important to reach a temperature of 100C for 20 min, assuming that NASA replicates the SOP from the Apollo missions, the air pressure will be lower and the temperature will only reach 60C at most.**

Evaluation Table

Team 1

6th REQ: Shall work on Mars

3rd CONCEPT: Symbology Satellite-Phone Call- 2D Camera to sense Parts-3d-printing-Boiling

- **0 Score.**
- **By literature sources optical satellites will allow for better communication with Mars, which is a plus, however the gravity of mars creates extra challenges for boiling water. The process will increase humidity in the base and around the sensitive electronics. Also boiling water behaves differently in lower gravity.**

Evaluation Table

Team 1

7th REQ: Shall have high robustness
3rd CONCEPT: Symbology Satellite-Phone Call-2D Camera to sense Parts-3d-printing-Boiling

- **0 Score.**
- By personal estimation this process has a low capability for overcoming adverse effects in areas such as the 2d camera and the disinfection by boiling, however the phone system on Earth is highly robust, and very unlikely to break down completely.

Evaluation Table

Team 1

8th REQ: Shall have high redundancy
3rd CONCEPT: Optical Satellite+Using compression algorithms to send files+360° 3D-Cameras+3d printing parts and tools+Chemicals, germicides

- **+1 Score.**
- By personal estimation the redundancy is drastically improved by having the ability to rapidly reproduce broken/damaged parts on the 3d printer.