

The background of the image is a composite of a blue starry space scene and a reddish-orange Mars surface. An astronaut in a full space suit is positioned in the upper center, with their right hand raised in a fist. A white rocket icon is placed behind the letter 'I' in the word 'EPIC'.

# EPIC

CHALLENGE JNS

# Fishbone Bullet Point Diagram



## ❖ People

- Wrong execution
  - Bad understanding
  - Not enough knowledge
  - Wrong instructions because people on earth can't relate
  - Wrong calculations during simulations
- Psychological issues
  - Feeling alone in Mars
  - Not being able to adapt into simulations
- Health issues
  - Not enough medical equipment and medicine
  - Lack of healthcare/medicare person

## ❖ Equipment

- Bad connection
  - Different angles for satellite
  - Weather issues of planets
  - Video of problem cannot be send to earth
- Broken seals
  - Doors cannot be opened and/or closed
  - "Opening doors" could lead to exposure of the whole facility
- Barcode issues
  - Barcodes are worn out/not readable
  - wrong entry into archive
- Hardware issues
  - Dysfunctional hardware after update
  - Worn out after hardware lifetime limit
  - Repair is impossible - total replacement

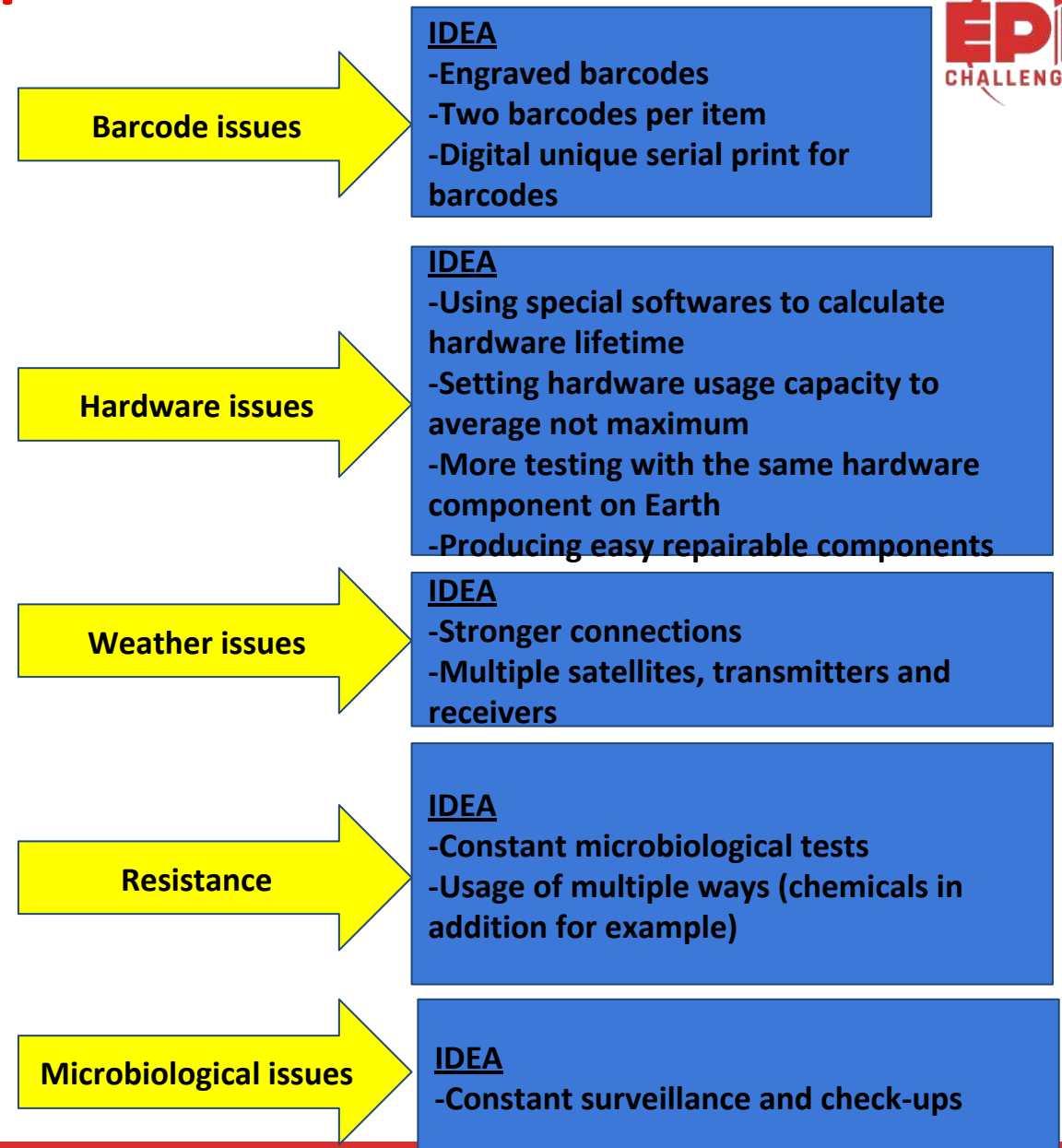
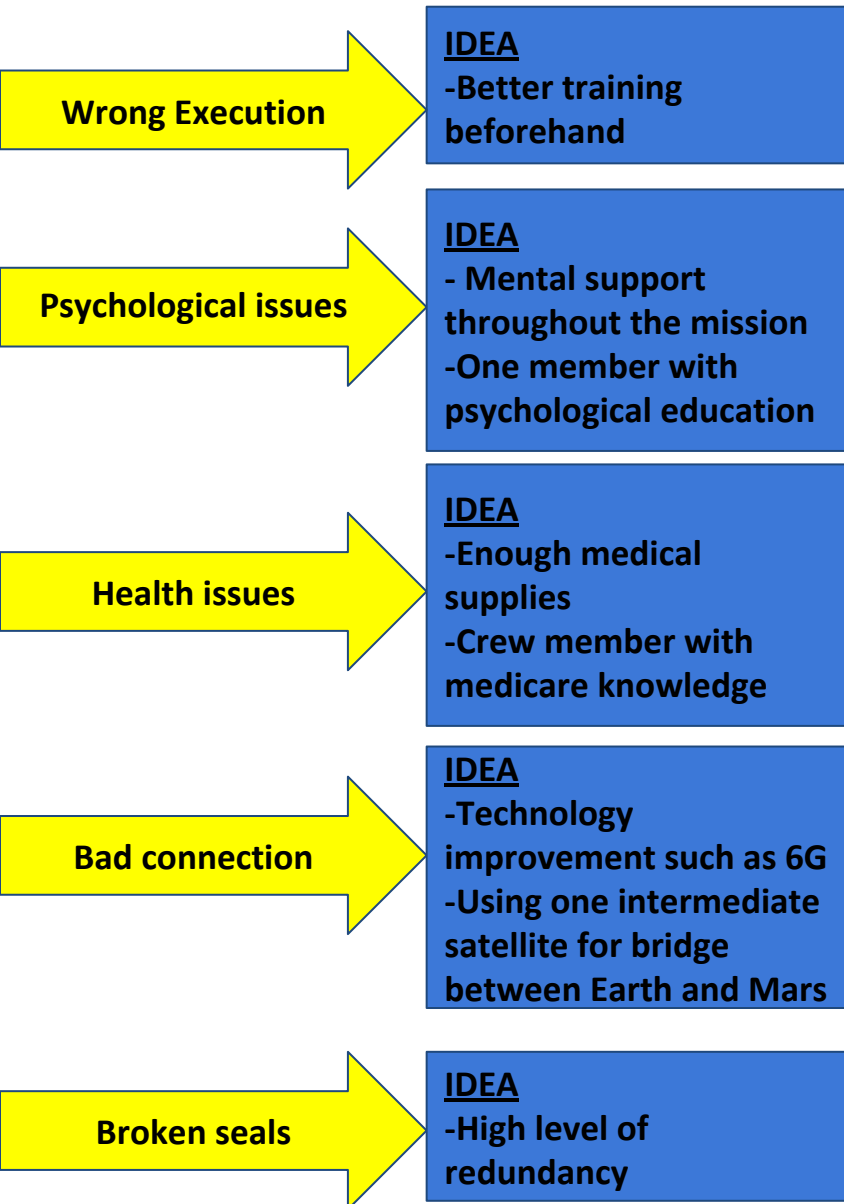
## ❖ Environment

- Weather issues
  - Sandstorms on Mars
  - Weather problems on Earth (clouds, hurricane,...)
- Resistance
  - Viruses/Bacteria develop resistance
- Microbiological issues
  - Unknown microbiological organisms sticking to spacecraft
  - Unknown side effect of microbiological organisms

### Concept-1

Video-Simulation for same situation-2d barcode alphanumeric-Xr/Vr instructions-Mars Environment

# Concept Improvement





# Concept Document

## Problem and Idea Title

Developing a system for solution of an unexpected issue -  
VR Instructions

## Author

Simon Plank, Halil I. Uluoglu

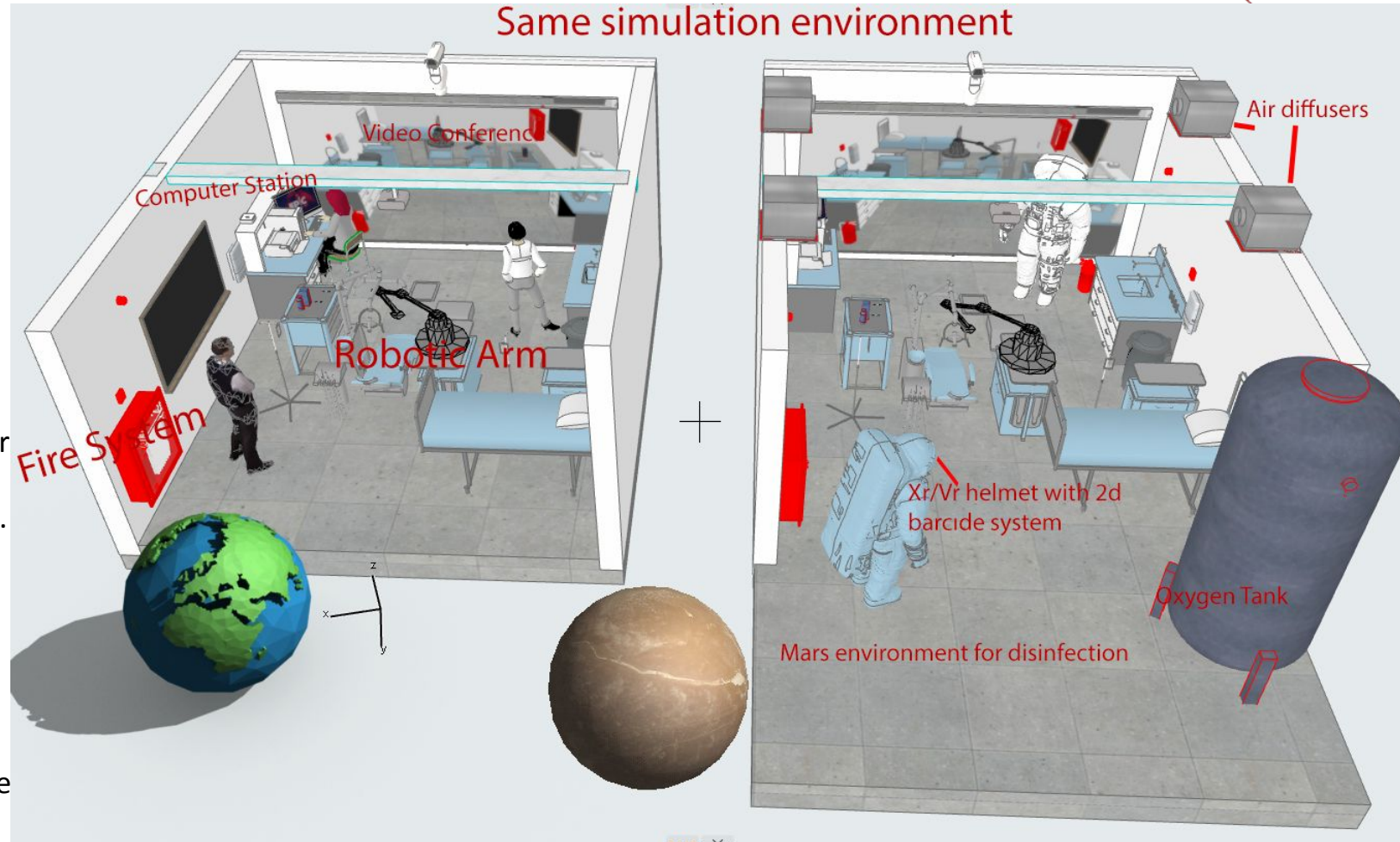
## Description

After sending videos of the issues that occurred after using the surgical robot system to Earth, scientists on Earth develop a strategy to repair the robotic surgery system by doing simulations on computers or with proper duplicates of the robotic system on Earth. Then they create instructions for the crew on Mars that can be viewed with VR glasses so that even persons with not sufficient knowledge can understand it. All needed parts and tools for the repair will be labeled with barcodes. To avoid mix-ups every item has two barcodes that are, if possible, engraved. To ensure a safe environment for operations the robot and the OR get disinfected by using Mars' cold temperatures. All viruses and bacteria will be killed when in contact with the cold (-80°C even during summer).

1. Sending video about emergency robotic surgery system
2. Using simulations to develop instructions for repairing the robotic surgery system
3. Connecting to VR glasses for applying the instructions
4. 2d barcode system for identifying parts and tools
5. Using Mars's conditions to disinfect the equipment

## Illustration with Keywords

Same simulation environment



PS: Own 3d creation using Archicad and Photoshop programs



PS: References and work file for 3d model are in the qr code.

# Fishbone Bullet Point Diagram



## People

- Astronaut Uses Chemicals Wrong
  - Chemicals were improperly labeled
  - Could not read label because they broke/forgot glasses
  - Instructions for mixing unclear
- Astronaut Has Wrong Tools
  - Did not ensure that they understood instructions from Earth
  - Did not select the right parts for the 3d printer
  - Base power tools are not charged
- Bad Instructions Sent From Earth
  - Wrong files for 360° 3D-Cameras
  - Used wrong compression algorithm
  - Did not understand the problem



## Equipment

- Satellite Does Not Send Correct Messages
  - Lasers on satellite are worn out
  - Satellite runs out of power
- 3d Camera Cannot Recognize Parts
  - Has the wrong files
  - Bad lighting
  - Battery not charged
- 3d Printer Does Not Provide Correct Parts/Tools
  - Broke from improper use
  - Printer wears out
  - Material not refilled
  - Wrong materials refilled

- Run Out of Disinfectant
  - Too much used previously
  - Not enough provided to Mars
  - Poor storage conditions "spoiled" chemicals



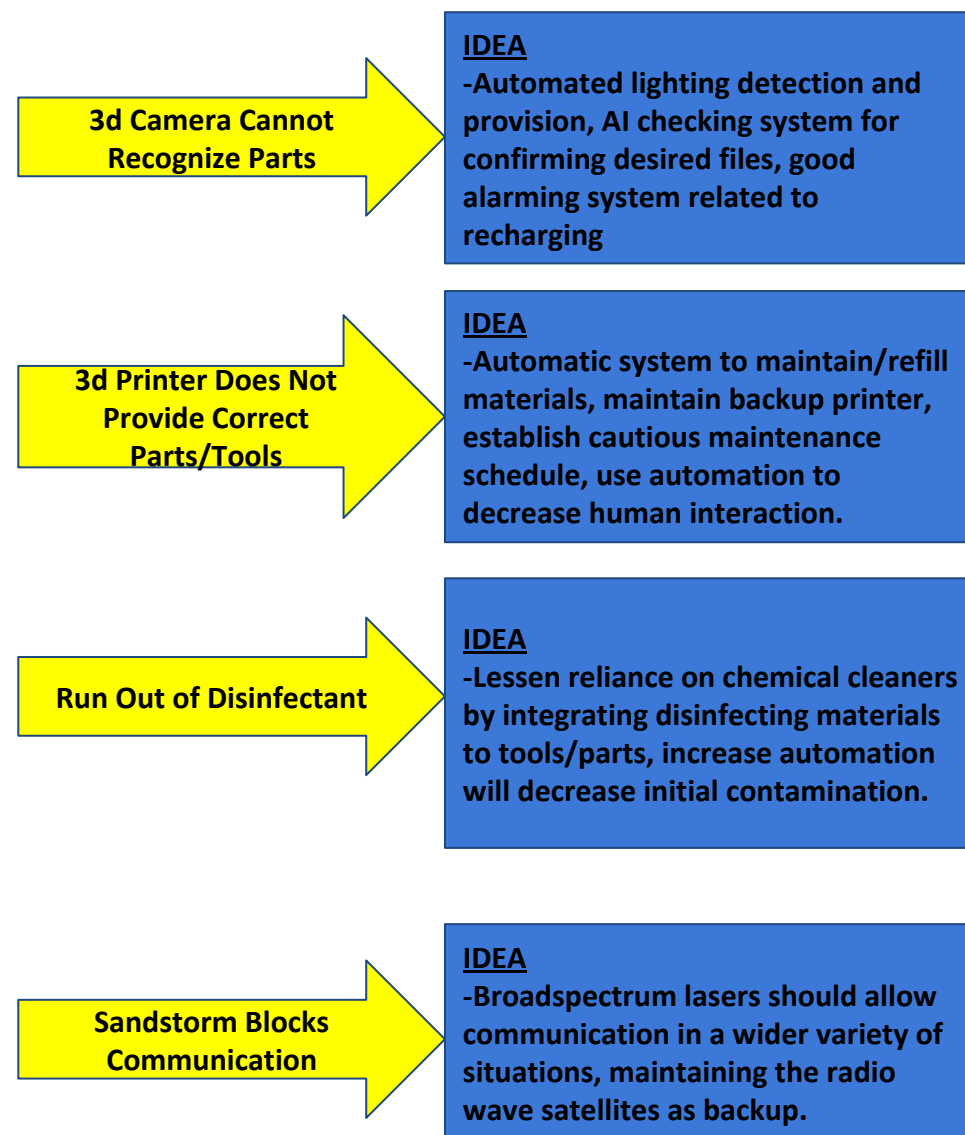
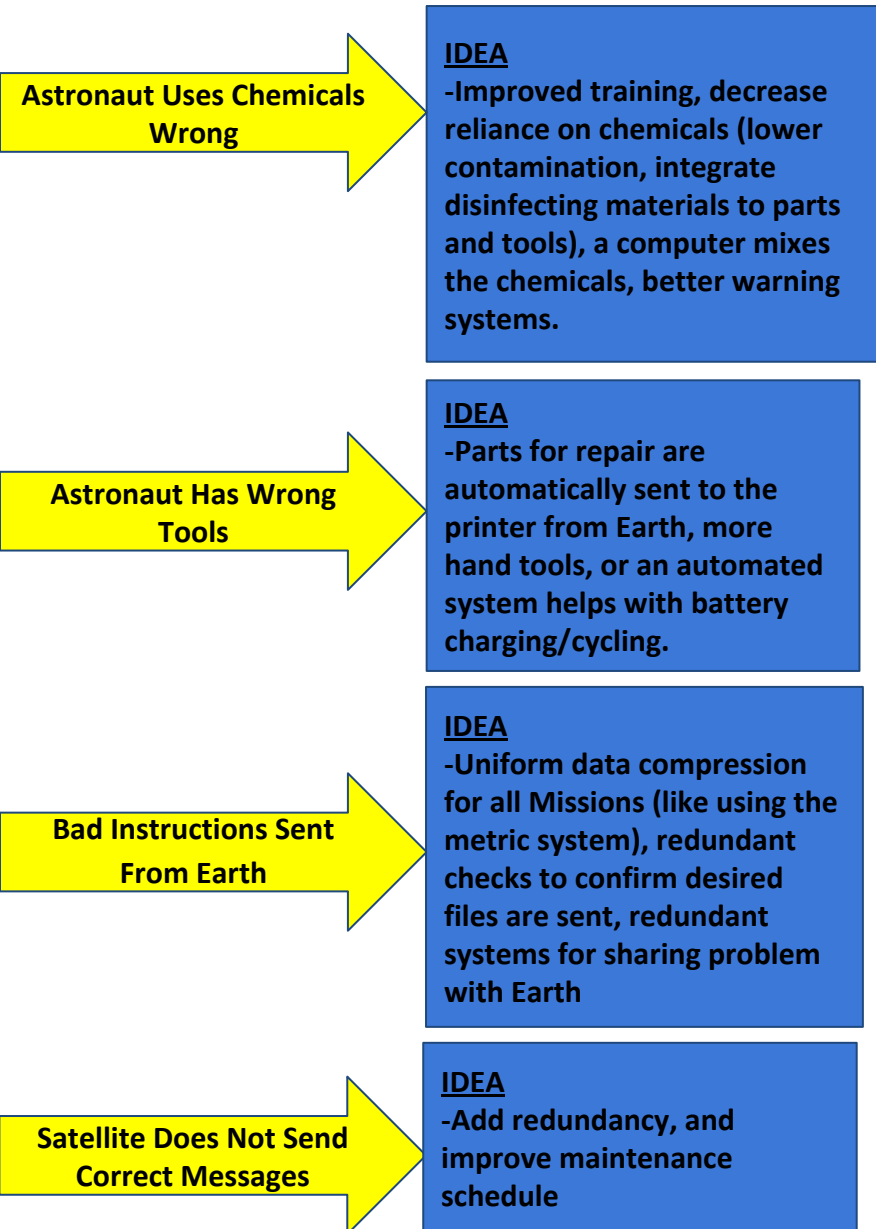
## Environment

- Sandstorm Blocks Communication
  - Lasers not strong enough to send/receive data
  - Atmosphere distorts signal too much

### Concept-2

Optical Satellite-Using compression algorithms to share files-360° 3D-Cameras-3d printing parts and tools-Chemicals, germicides

# Concept Improvement





# Concept Document

## Problem and Idea Title

Developing a system for solution of an unexpected issue - Optical Systems

## Author

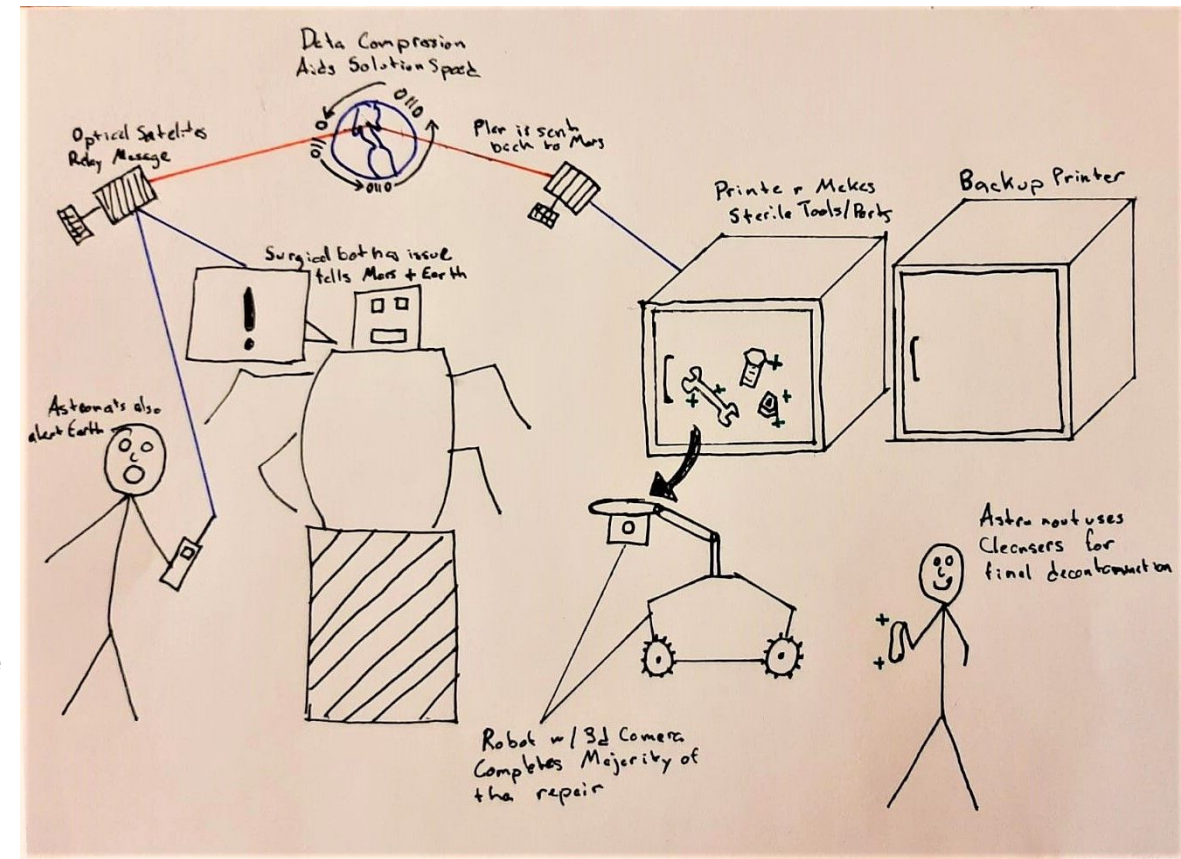
Charles Rambo, Masoud Rastgou

## Description

Should there be a novel failure of the surgical robot on Mars, The initial surgical robot failure is recorded by both an automated reporting system, and warnings are relayed to the astronauts via word/symbol warnings. The problem is communicated to Earth by both the system and astronauts through a system of optical satellites which are designed with broad spectrum lasers to communicate through the atmosphere and are stationed such that the Sun nor Mars is fully in their path. Earth will use compression algorithms to allow faster communication, and larger file transfer. The instructions will be relayed back to Mars via the same satellite network. A 3d/ 360 camera will help the astronauts establish which parts are necessary. It will have a backup and extra lighting to help make sure that it is able to function. It will also aid the astronauts in establishing that the correct parts and tools have been produced by the 3d printer. The parts and tools (with a preference for hand tools) necessary for the repair will automatically be sent to the Mars based 3d printers with print materials continuously maintained by an automated system. The print materials will have antimicrobial materials added such as silver such that they will be naturally antimicrobial. Having used antimicrobial parts and tools to rebuild the surgical robot, the main concern will be chemical contamination, where possible the repairs will be handled by a robot to decrease this, and other biological robot contamination. Finally, a small amount of chemicals will be used to clean the surgical such that it is ready for use.

1. Problem is reported by astronauts, automated systems, and sent to Earth via broad spectrum optical satellites.
2. Earth uses compression algorithms to speed communication, and develop a solution.
3. A 3d/ 360 camera identifies parts.
4. 3d printer creates sterile parts and tools to be used in the repair.
5. Human contact is minimized, and chemicals are used for a final disinfection.

## Illustration with Keywords



PS: References for this document are in the qr code.

# Fishbone Bullet Point Diagram



## People

- Psychological Issues
  - Human mistakes (losing focus, impatience, misunderstanding...)
  - Pressure (time pressure, anxiety)
- Physical issues
  - Problems with gravitation (Earth:  $9,8 \text{ m/s}^2$  ; Mars:  $3,7 \text{ m/s}^2$ ; low gravity reduces the strength of bones and muscles)
  - High radiation exposure (2.5 times higher than in the international space station)



## Equipment

- Malfunction of satellites (loss of communication during critical mission events, such as landing on Mars)
  - Overload of the DSN antenna (they track all spacecraft flying throughout our solar system)
- Cable fire or sensor-error of the 2D cameras
  - Transmission-issues of videos and images (2D-camera)
  - "Accidents" (dropping items on the ground)
  - For Boiling: water is rare on Mars!
  - Imprecise product from the 3D-printer (bad calibration)
  - Boiling is energy-intensive
  - Software issues on the 3D-printer
  - Climate impacts on machines (f.e. rust)
  - "Cold problems" for machines (up to -120 degrees)
  - Satellite does not send correct Messages (lasers on satellite are worn out or satellite runs out of power)



## Environment

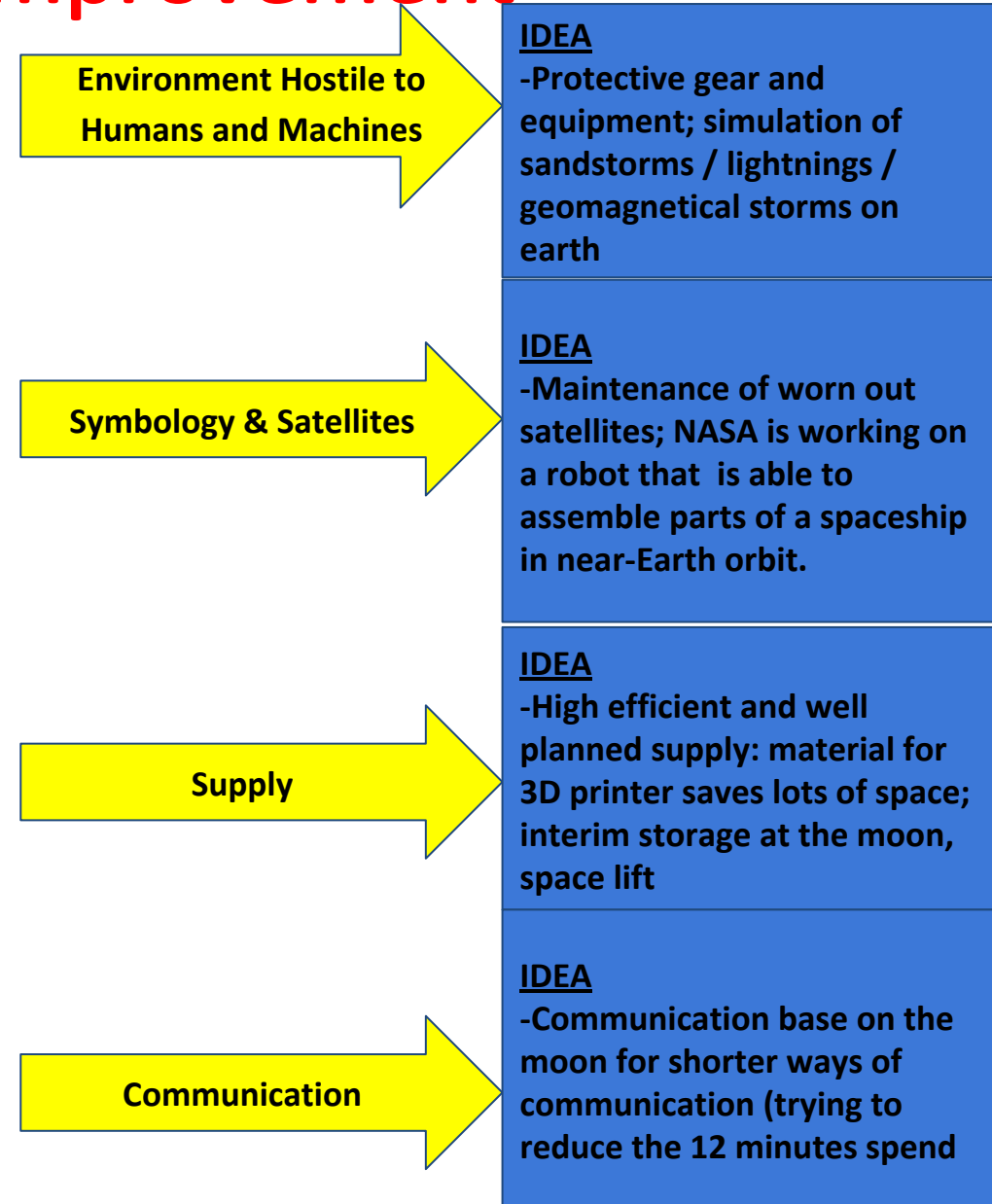
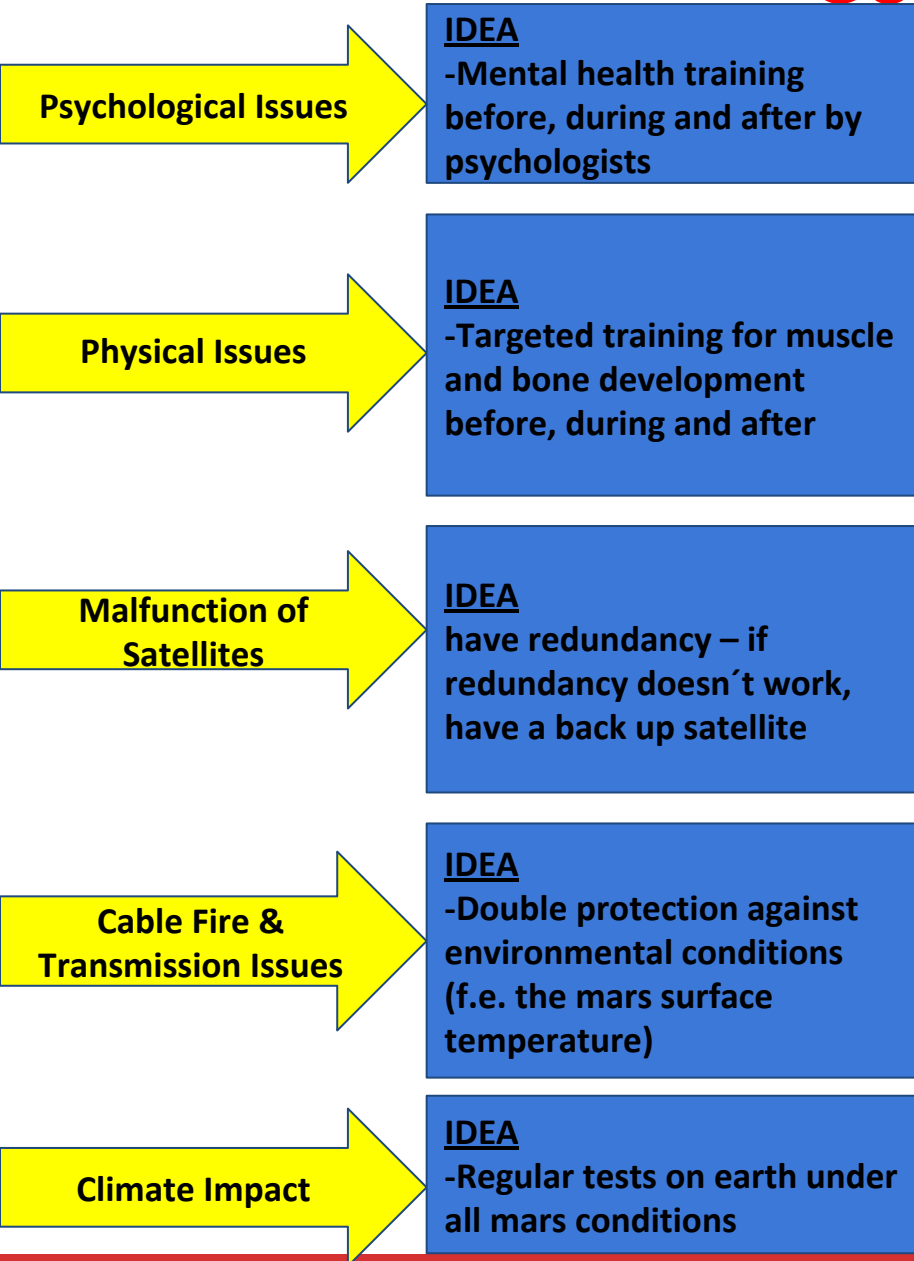
- Environment hostile to humans and machines
  - Sandstorms, lightnings, geomagnetical storms
  - Climate change (+20 to -120 degrees)
- Distance (212.000.000 kilometers)
  - Supply
  - Communication

### Concept-3

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



# Concept Improvement



# Concept Document

## Problem and Idea Title

Developing a system for solution of an unexpected issue -  
Technical robotic failure

## Author

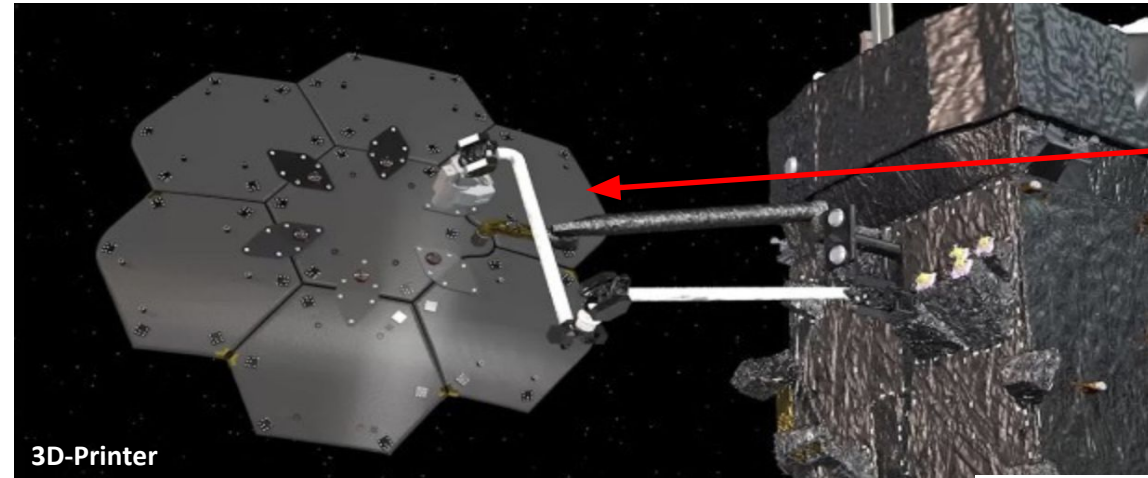
Lennart Jehle, Erik Kalmar, Lukas Mitmasser

## Description

After using free-space optical communication and satellites to send the description of the technical issue to experts on earth, these scientists work together via conference call on a solution. This conference call is in constant information exchange with the astronauts. While the experts wait for a reply they already work on further steps. To identify the parts, the astronauts use 2D cameras to sense the parts and the 3D printer to produce replacement parts. All those parts are going to be disinfected by boiling water that cleans and disinfects at the same time.

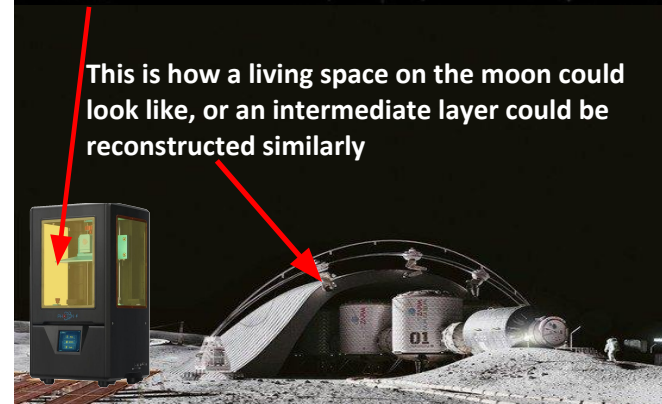
1. Using free space optical communication and satellites to communicate with experts on earth
2. Taking part in a call conference to find a solution and receive instructions
3. Using 2D cameras to sense the parts in the surgical robot
4. Parts that are defect can be replaced with identical parts what can be produced by a 3D printer
5. All the parts will be disinfected by boiling water before being used

## Illustration with Keywords



3D-Printer

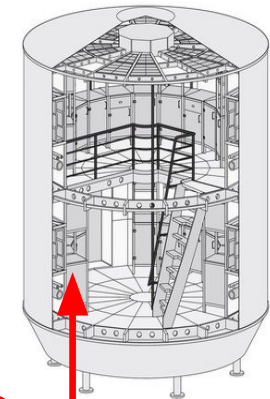
This robot arm can maintain satellites or assemble structures in space.



This is how a living space on the moon could look like, or an intermediate layer could be reconstructed similarly



Scientists have developed a work and living station for political relationships on the Moon and Mars. To reduce the amount of time to supply material, NASA could also build an interim storage.



First test module for a laboratory on Mars



PS: References for this document are in the qr code.