IV. Appendices

Appendix 1 The history of crewed space missions

This appendix is a continuation of the section *1.1 Brief history of past crewed missions*. It is presented separately because it is not essential for the topic of this thesis, however it provides a valuable historical context and continuation of the discussed topic.

Before sending humans to space, the important part of the research was testing on living organisms. Robots and animals became space travellers. Americans were sending monkeys, Soviets dogs. The most famous were Soviet dog Laika and Mercury's chimpanzee Ham. Laika died aboard Sputnik 2 in 1957, Ham returned to Earth to a comfortable retirement at the National Zoo in Washington, D.C. (Dohrer, 2017; National Geographic, n.d.). However, the first mammal in space became Albert II, a Rhesus monkey in 1949. Previous Albert I's mission was not successful. Albert II was anesthetized during flight and implanted with sensors to measure his vital signs. He died upon impact at re-entry (Dohrer, 2017).

The NASA's human spaceflight program started with Project Mercury. This project was launched in 1958. About a year after the U.S.S.R. had signified the start of the Space Age with the successful launch of their satellite Sputnik 1 (National Geographic, n.d.).

The Cold War between the United States and Soviet Union started the space race, an unprecedented program of space exploration and crewed space missions. The Soviets sent Yuri Gagarin, the first person in space on 12th of April, 1961. In response to that, President John F. Kennedy challenged the U.S. by saying: "*To achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to earth.*" Eight years and three NASA's programs - Mercury, Gemini and Apollo later, it was achieved (NASA, n.d.-e).

About a month later upon Yuri Gagarin's spaceflight, Alan Shepard, Jr. became the first American in space (May 5, 1961) aboard Mercury-Redstone 3. Between 1961 and 1963, six manned one-man missions went to space as part of the Mercury project. In February 1962 John Glenn became the first American who orbited the Earth (National Geographic, n.d.).

The following NASA's Gemini program (Gemini in Latin means "Twins") was a series of 12 two-man spacecraft launched into orbit around Earth by the U.S. between

1964 and 1966. The Gemini program was designed to test the ability of astronauts to manoeuvre the spacecraft by manual control. The Gemini series, helped to develop the techniques for orbital rendezvous and docking with a target vehicle. During the Gemini 4 mission (June, 1965), astronaut Edward H. White performed the first American spacewalk. Gemini 5 (Aug., 1965) completed an eight-day mission, the longest spaceflight undertaken up to that time (Britannica, n.d.-b; National Geographic, n.d.).

In meantime, Soviet cosmonaut Aleksei Leonov (Алексей Архипович Леонов) became the first person to exit an orbiting spacecraft Voskhod 2 in March 1965. He got into critical situation when he could not fit into airlock hatch due to his inflated spacesuit (Britannica, n.d.-a; Иванов, Аносов, Квасников, Розенблюм, & Столовски, 2009).
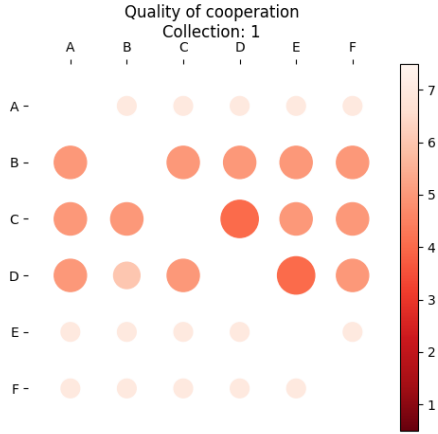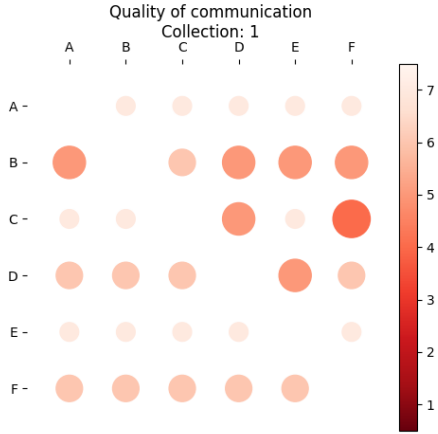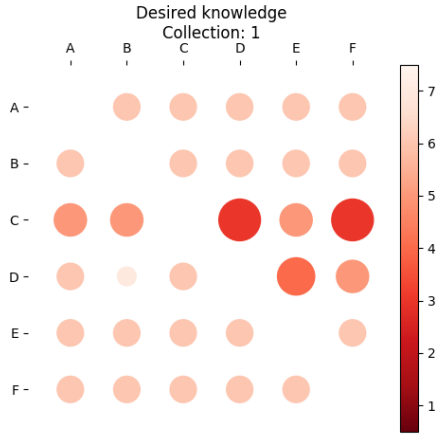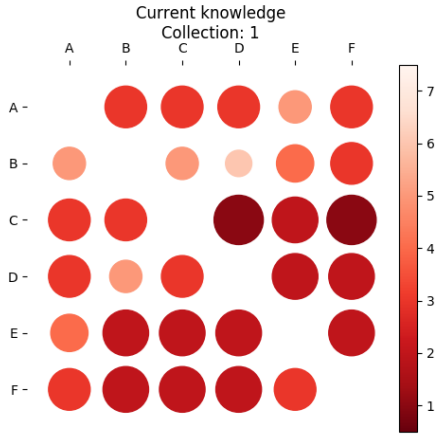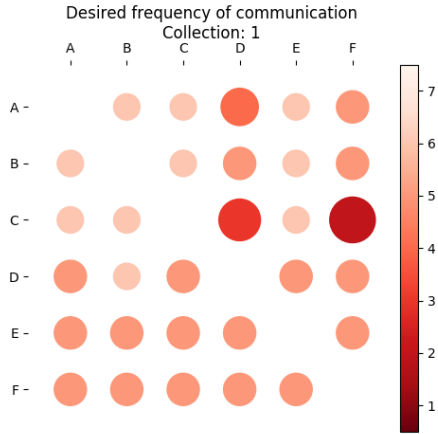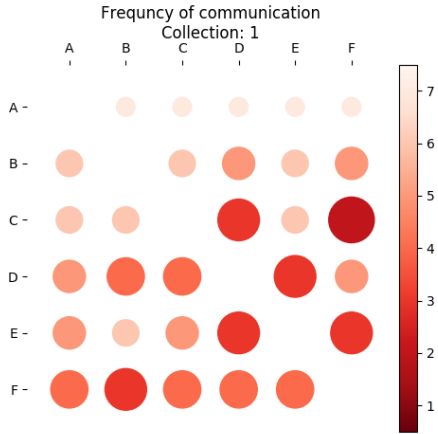
Before the first Apollo flight astronauts Virgil Grissom, Edward White, and Roger Chaffee died in a launchpad fire during training. After several of Apollo speceflights, Apollo 11 with commander Neil Armstrong, Command Module Pilot Michael Collins and Lunar Module Pilot Edwin "Buzz" Aldrin became the first mission to reach the Moon when they landed in the Sea of Tranquility on July 20, 1969. Before Apollo program ended on 1972 five more missions flew to Moon (NASA, 2017; National Geographic, n.d.).
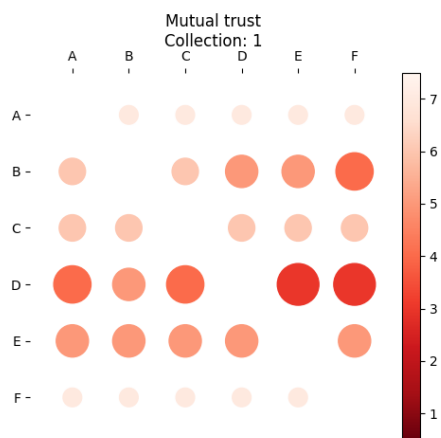
After the end of the Apollo project, Skylab expeditions were paving the way for the collaborative ISS project. One of the Skylab's primary achievements was observations of the Sun. The US-Soviet political tensions that had accelerated the space race was slowly dropping in 1970s. Apollo-Soyuz Test Project gave way to cooperation between them. The political tensions that had accelerated the space race began to thaw. International collaboration became the norm during the space shuttle era and current cooperation with the International Space Station which includes many nations (NASA, n.d.-e).

Space shuttle, officially called the Space Transportation System (STS), became the first reusable spacecraft transporting humans. There was six Space shuttles Enterprise, Columbia, Challenger, Discovery, Atlantis and Endeavour that together flew 135 missions and carried 355 different people to space during over 30 years. Enterprise was the first of space shuttles but it never flew in space, only made tests. First STS in space was Columbia (April, 1981). Space shuttles launched, recovered and repaired satellites and built the largest structure in space, the ISS. Two crews of seven astronauts
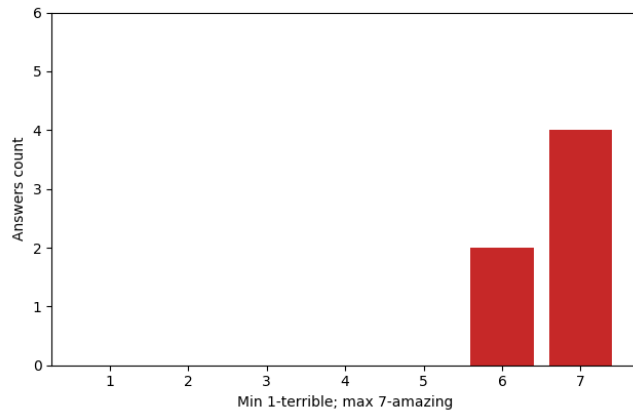
died tragically during the era of Space Shuttle - Challenger accident in 1986 and Columbia accident in 2003 (NASA, n.d.-h, n.d.-i, n.d.-e, n.d.-j).
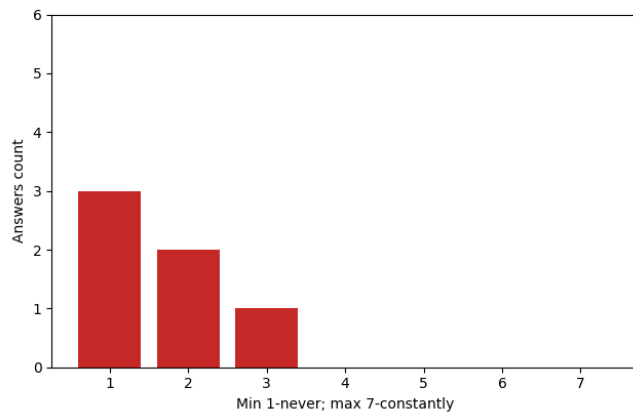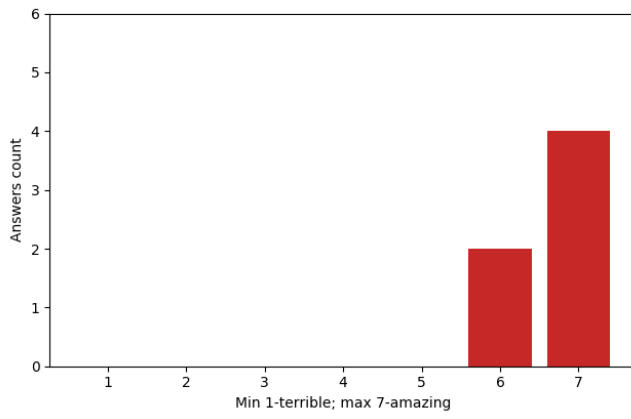
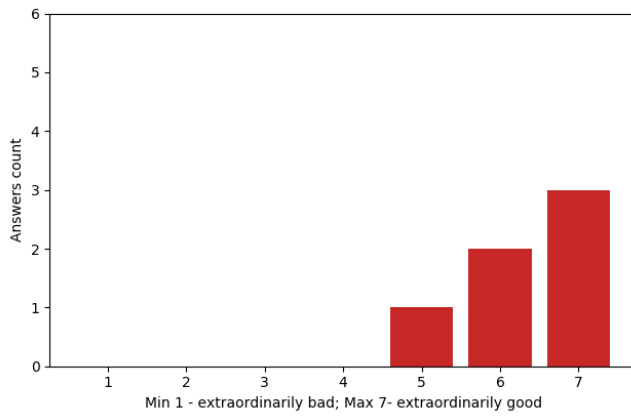# Appendix 2 LUNEX-0 results

Frequncy of communication
Collection: 1

Desired frequency of communication
Collection: 1

Current knowledge
Collection: 1

Desired knowledge
Collection: 1

Quality of communication
Collection: 1

Quality of cooperation
Collection: 1

Mutual trust
Collection: 1

Atmosphere within the team
Data collection: 1

Answers count

Min 1-terrible; max 7-amazing

Misunderstandings within the team
Data collection: 1

Answers count

Min 1-never; max 7-constantly

Atmosphere within the team
Data collection: 2

Min 1-terrible; max 7-amazing

Team performance
Data collection: 2

Min 1 - extraordinarily bad; Max 7- extraordinarily good
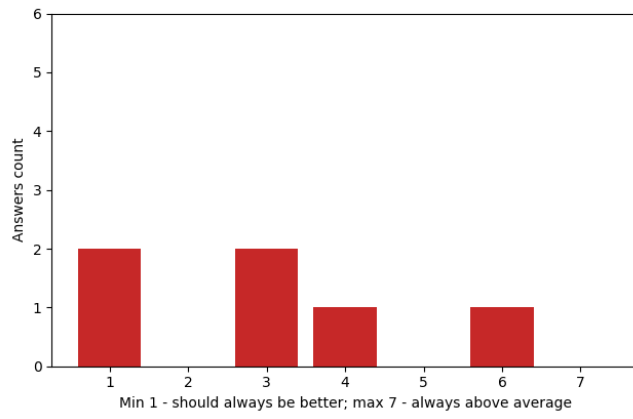
Misunderstandings between crew and MCC
Data collection: 2

Min 1-never; max 7-constantly
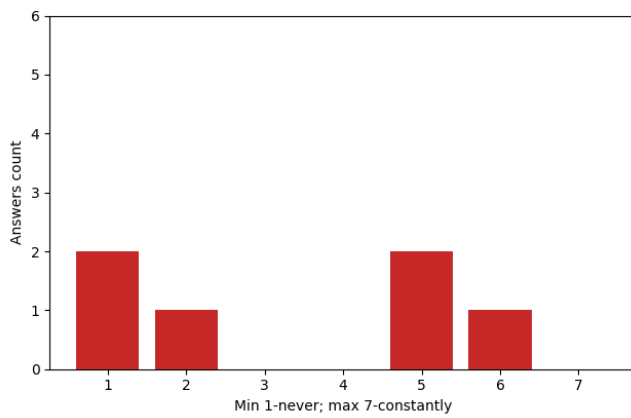
MCC trust
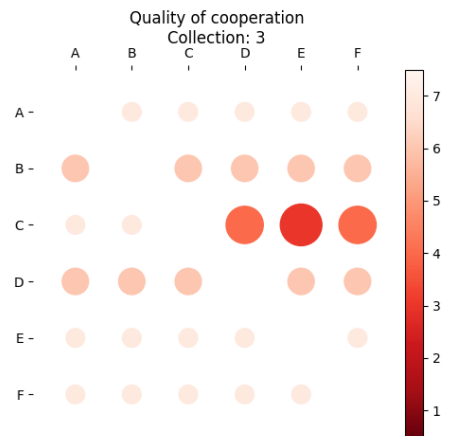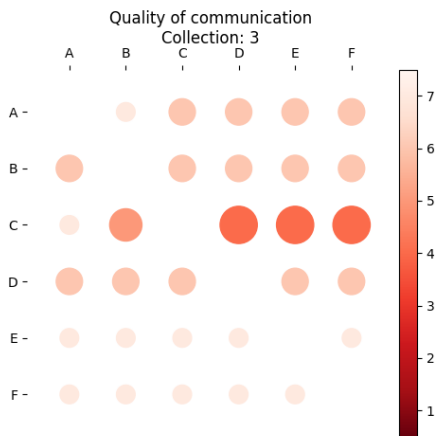### Data collection: 2

Min 1 - not at all; max 7 totally
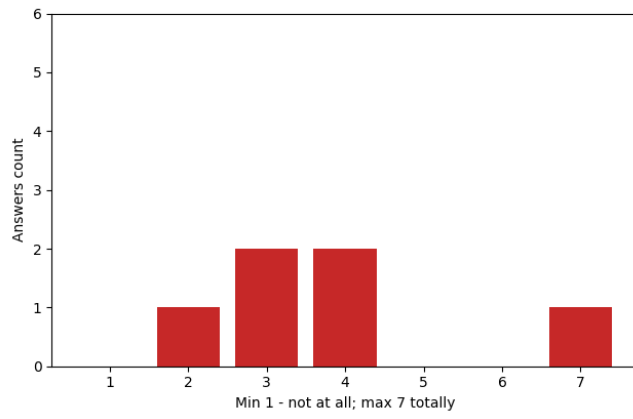
MCC information sufficiency
Data collection: 2
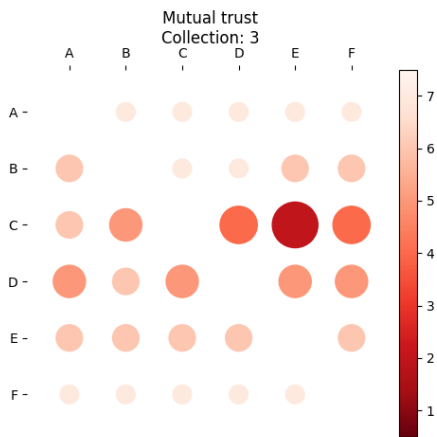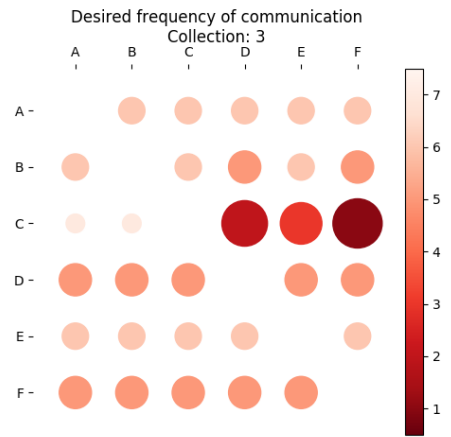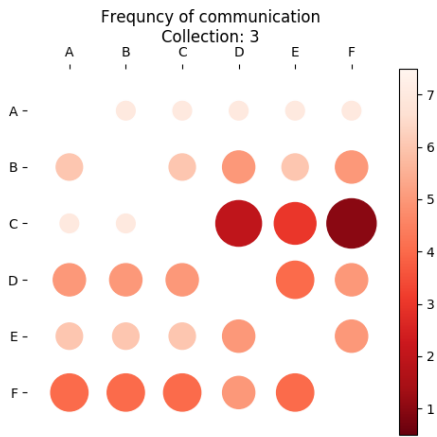
Min 1 - should always be better; max 7 - always above average

Frequncy of communication
Collection: 3

Desired frequency of communication
Collection: 3

Quality of communication
Collection: 3

Quality of cooperation
Collection: 3
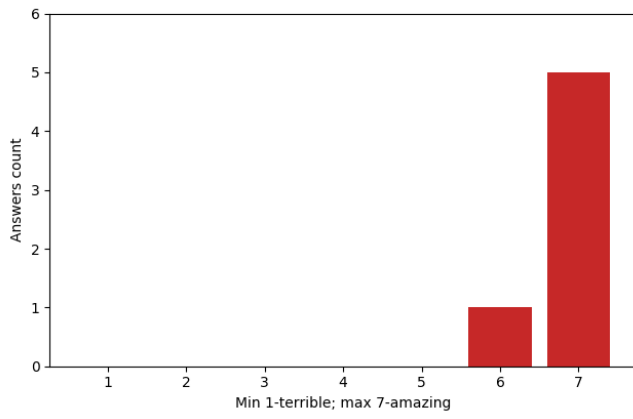
Mutual trust
Collection: 3

Atmosphere within the team
Data collection: 3

Answers count

Min 1-terrible; max 7-amazing

Misunderstandings within the team
Data collection: 3

Answers count

Min 1-never; max 7-constantly

Mutual trust
Collection: 4

Atmosphere within the team
Data collection: 4

Answers count (y-axis)
Min 1-terrible; max 7-amazing (x-axis)
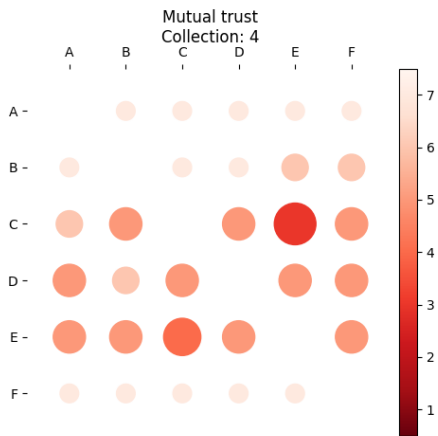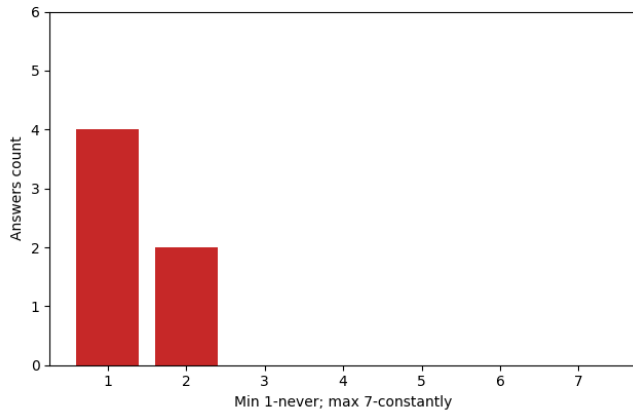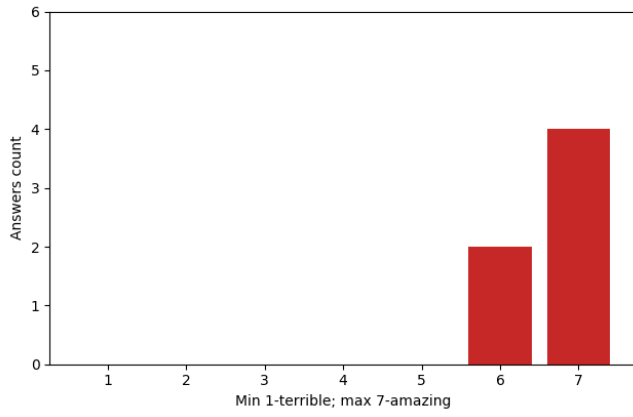
The level of discomforts
Data collection: 4

Answers count (y-axis)
Min 1-no discomfort; max 7- very high (x-axis)
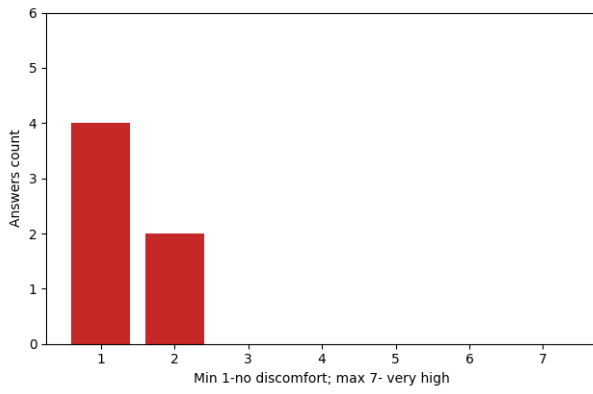
Cooperation with ESTEC MCC
Data collection: 4
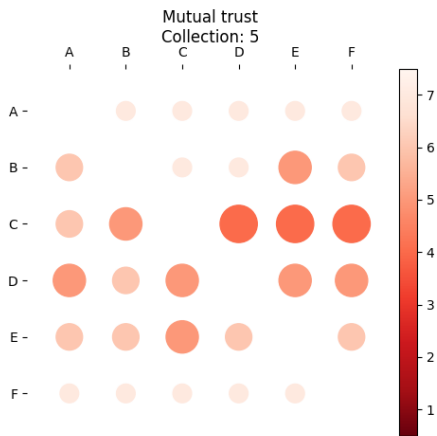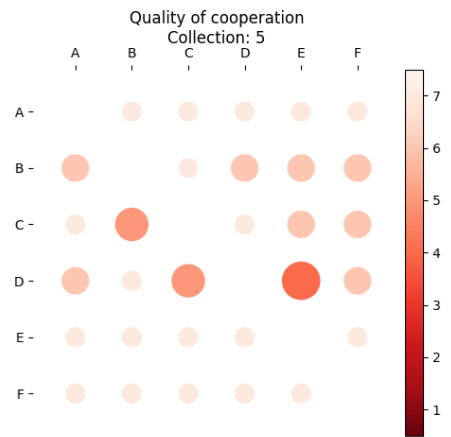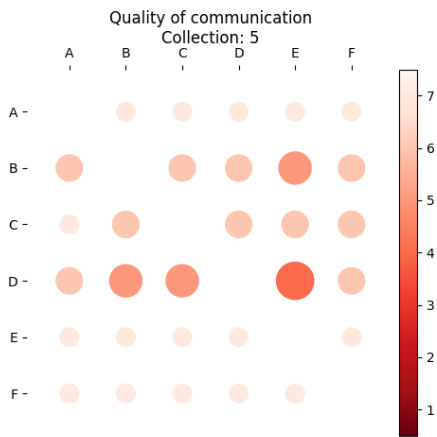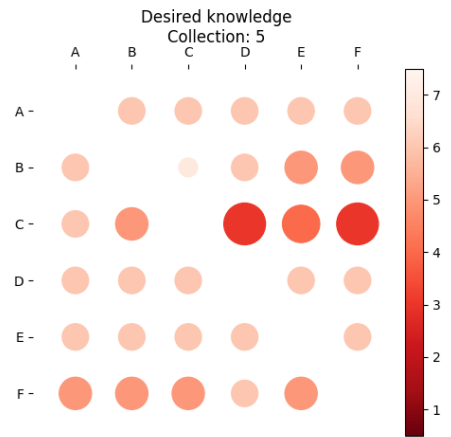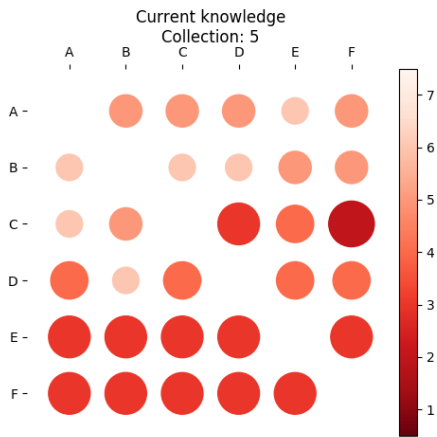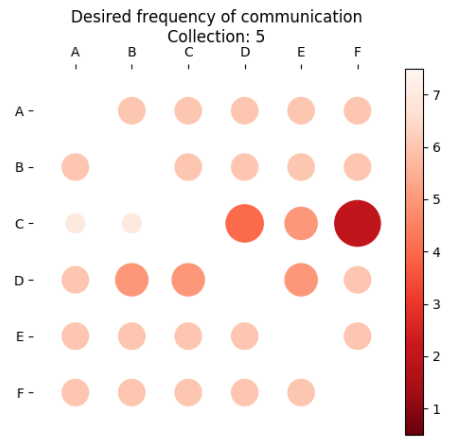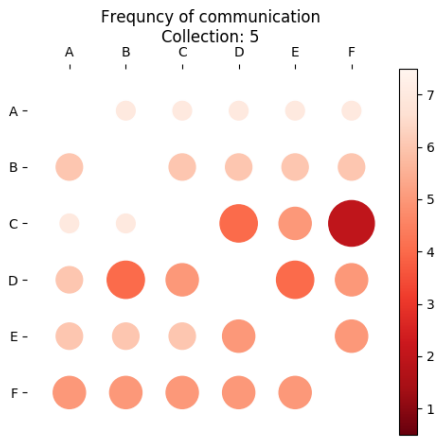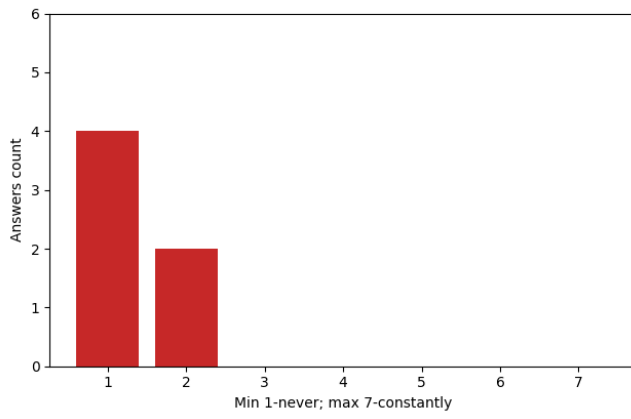
Answers count (y-axis)
Min 1-totally insufficient; 7-excellent (x-axis)

Frequncy of communication
Collection: 5

Desired frequency of communication
Collection: 5

Current knowledge
Collection: 5

Desired knowledge
Collection: 5

Quality of communication
Collection: 5

Quality of cooperation
Collection: 5

Mutual trust
Collection: 5

Misunderstandings within the team
Data collection: 5

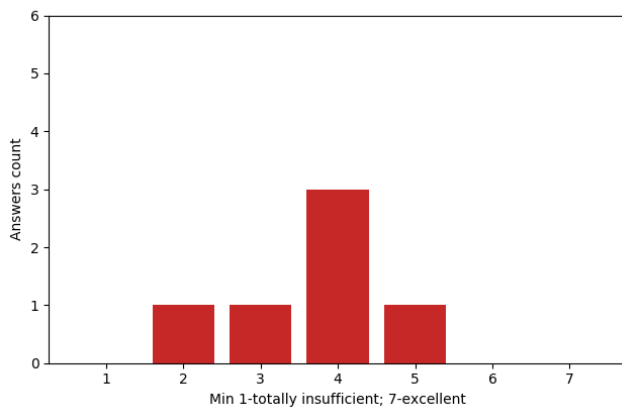Min 1-never; max 7-constantly

Atmosphere within the team
Data collection: 5

Min 1-terrible; max 7-amazing

Team performance
Data collection: 5

Min 1 - extraordinarily bad; Max 7- extraordinarily good
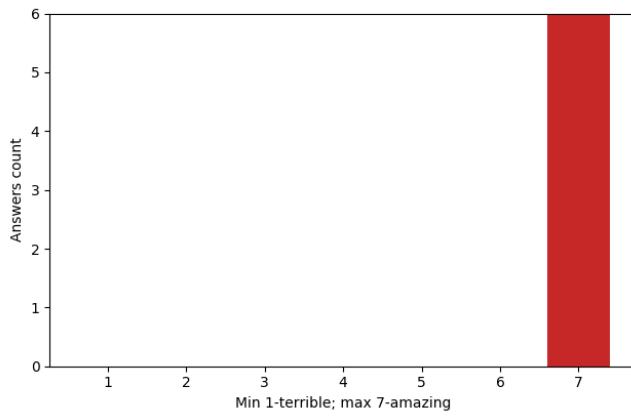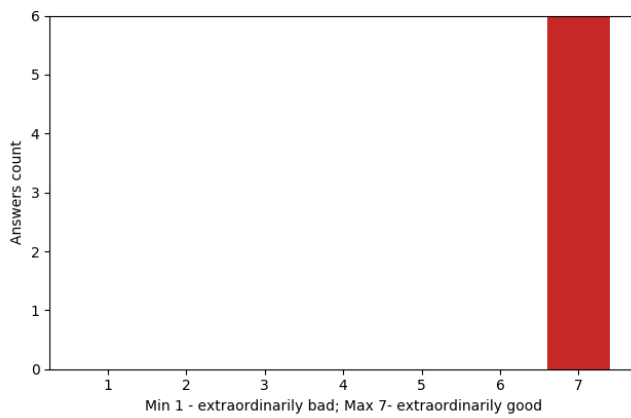
Appendix 3 LUNEX-1 results

Frequency of communication
Collection: 1

Desired frequency of communication
Collection: 1

Quality of communication
Collection: 1

Quality of cooperation
Collection: 1

Personal preferences
Collection: 1

Frequency of communication
Collection: 2

Desired frequency of communication
Collection: 2

Quality of communication
Collection: 2

Quality of cooperation
Collection: 2

Personal preferences
Collection: 2

Frequency of communication
Collection: 3

Desired frequency of communication
Collection: 3

Quality of communication
Collection: 3

Quality of cooperation
Collection: 3

Personal preferences
Collection: 3

Frequency of communication
Collection: 4

Desired frequency of communication
Collection: 4

Quality of communication
Collection: 4

Quality of cooperation
Collection: 4

Personal preferences
Collection: 4

Frequency of communication
Collection: 5

Desired frequency of communication
Collection: 5

Quality of communication
Collection: 5

Quality of cooperation
Collection: 5

Personal preferences
Collection: 5

Frequency of communication
Collection: 6

Desired frequency of communication
Collection: 6

Quality of communication
Collection: 6

Quality of cooperation
Collection: 6

Personal preferences
Collection: 6

Frequency of communication
Collection: 7

Desired frequency of communication
Collection: 7

Quality of communication
Collection: 7

Quality of cooperation
Collection: 7

Personal preferences
Collection: 7

Satisfaction with MCC

Flight director   Scheduling officer   CapCom

Average score

Data collection