SpaceOps-2023, ID #532

Human Factors and Behaviors in Operations

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ABSTRACT

Commonly, technical operations are core to the success and sustainability of a space operations organization. As a software developer in the space industry, creating technological solutions that automate or simplify operations processes is crucial. But what if the provided system is met with resistance ? In the face of resistance would it be the user's fault or system design flaws? The benefit of having a well-designed system that includes automation reduces human error, and it standardises practices which creates familiarity and consistency. Though the developer may have tested the system thoroughly for efficiency, its business practicality is dependent on the end-user. To ensure some of the business-critical functions are efficient, online (easy to access/remote) and secured, a system was developed. This system would automate most functions that were done manually. The system promised data accuracy and reduced human error. The end users were trained and a successful go-live was recorded. A month after implementation, the system was reportedly not used. Research was done both focusing on the system and behaviour of user towards operations. This paper focuses on human factor and behaviour in operations.

1. Introduction.

For many years, SANSA technical team captured acquisition of signal (AOS) and loss of signals (LOS) times manually. The process included manually configuring High Data Rate Modem (HDRM) Programable Demodulator for the next satellite pass. This would prepare the correct antenna in position and enabling streams for data transmission/receipt. This process was followed by writing down on paper AOS and LOS times as the pass happens. This manual process was vulnerable to information loss, incorrect data capturing and sometimes missed passes due to late/no configurations to the demodulator. Information was not saved anywhere besides on paper and the information was not accessible through any other media but a physical paper.

To reduce the effect of human error in satellite operations in SANSA HBK, the Mission Assistance Software (M.A.S) was designed to automate the process of acquiring signal times of satellite passes to increase data

accuracy.

M.A.S contains both automatic and manual configurations. The auto mode configures the HDRM to enable stream of correct antenna for next satellite pass three minutes prior. It then captures AOS at the beginning of the pass and LOS at the end of the pass, saves the information on a file specified on an online drive accessible to everyone, typically SANSA HBK employees, who may require it. The manual mode does the same function with a single press of a button.

Human factors examines the way human capabilities behaviour effect the system.

1.1 *Literature Review*

According to (Heinrich, et al., 2021) [1], "Increased research into boredom, complacency, habituation, and vigilance as they relate to satellite operations is required due to a lack of prevalence in the literature".

In a study on Remote ship operation, (Kari & Steinert, 2021)[2], list 13 human factors that were identified that can affect remote operations in the shore control centre as follows: " three factors affect human-human interactions, eight factors affect human-machine interactions and two factors can affect both human-human and human-machine interactions."

As satellites are also operated remotely, satellite operators are also not immune to the factors mentioned by (Kari & Steinert, 2021). Since
human operators play an important role in satellite operations, (Kari & Steinert, 2021), argues that "human factors can significantly affect the performance and reliability of operations." This can result in errors that can lead to losses of critical satellite missions.

1.2 New system introduction to user

M.A.S was introduced to the users and the following training formed part before the system was placed in use.

Before any training software developers must go through the following questions to better understand the users:

I. What kind of work do the user do?

II. What percentage is their knowledge on the training they about to do?

III. What is detected with their behaviour towards their work?

With all these, it will help software developers on how to conduct the training of the new software. Purpose of the training would be to accomplish a better understanding of the system and for it to offer its full capabilities to the user.

2. Material and methods.

Training offered to users before any interaction with the system was computer related basics that will be sometimes needed to be done in relation with the system about to be released.

I. Mapping a network drive on the computer.

II. Firewall rules.

III. Basic understanding of client and server communication.

To reduce some of the problems as a developer it is best to train/show users all they need to know before interacting the software.

2.1 Training continuity

Sharing every detail step by step rather than assuming reduces problems that may be accounted later at interacting with the system. The focus was interacting with the system now mostly on how to use.

User guide was drafted and provided to all users that will be using the system in advance, for users to go through it before training. The training would take a week to accommodate every user and ensure clear understanding. The training about system functionality was done and after training the system was ready to offer its services.

Globally systems face resistance and SANSA space operation (M.A.S) was not unique to this as it was later reported not used and further research had to be done. It focused on both the system and human factors.

3 System and human factors.

It's important to user understands the tools around and have techniques used to familiarize themselves overtime.

3.1 Human factors that were detected during research.

I. Lack of commutation within the team was observed.

II. Ignorant in most of the tools around, that if not used daily it becomes a problem when time comes for them to be used.

III. Not paying ATTENTION / FOCUS during training .

IV. Attitude towards the new technology and developer.

V. Hard times in adapting to new methods/technology.

VI. Forcing the system to perform beyond what it designed to do.

3.2 System factors

I. System Graphical User Interface design was confusing to user

II. Developer of the system was not trusted by the users.

III. The user feels like the system is not really solving the problem, as they still had to do some configurations.

From the system factors given by users, developer came up with the following output that will be used to help in improving the system.

A simple thing as a button that does not show proper color changes can lead to frustrations to user, if whether its grey or red but still performs same purpose.

No indicator to show whether the system is running perfect and connected in relation to client and server that is new to user. The way that is designed take M.A.S was designed in a way that it depends on existing system, that when it has problems affects the system dependent on it. All this were discovered during and after interacting with the system and based on that some changes had to be made during system down time.

4. Results

I. After individual interview was conducted to get feedback on what was problems were encountered with the system, the user came up with the following solution.

II. What could be done to improve the software?

- ✓ User interface re-design.
- ✓ Button functionality had to show proper button changes.
- ✓ Re-training
- ✓ Functionalities that can be added to ensure more automation.
- ✓ Strictly forbiting the usage of the last method on witting on paper changed the user mentality to focus more on the system training and know how to use.

The implemented solution gave positive results that led the system to be used to its full capability.

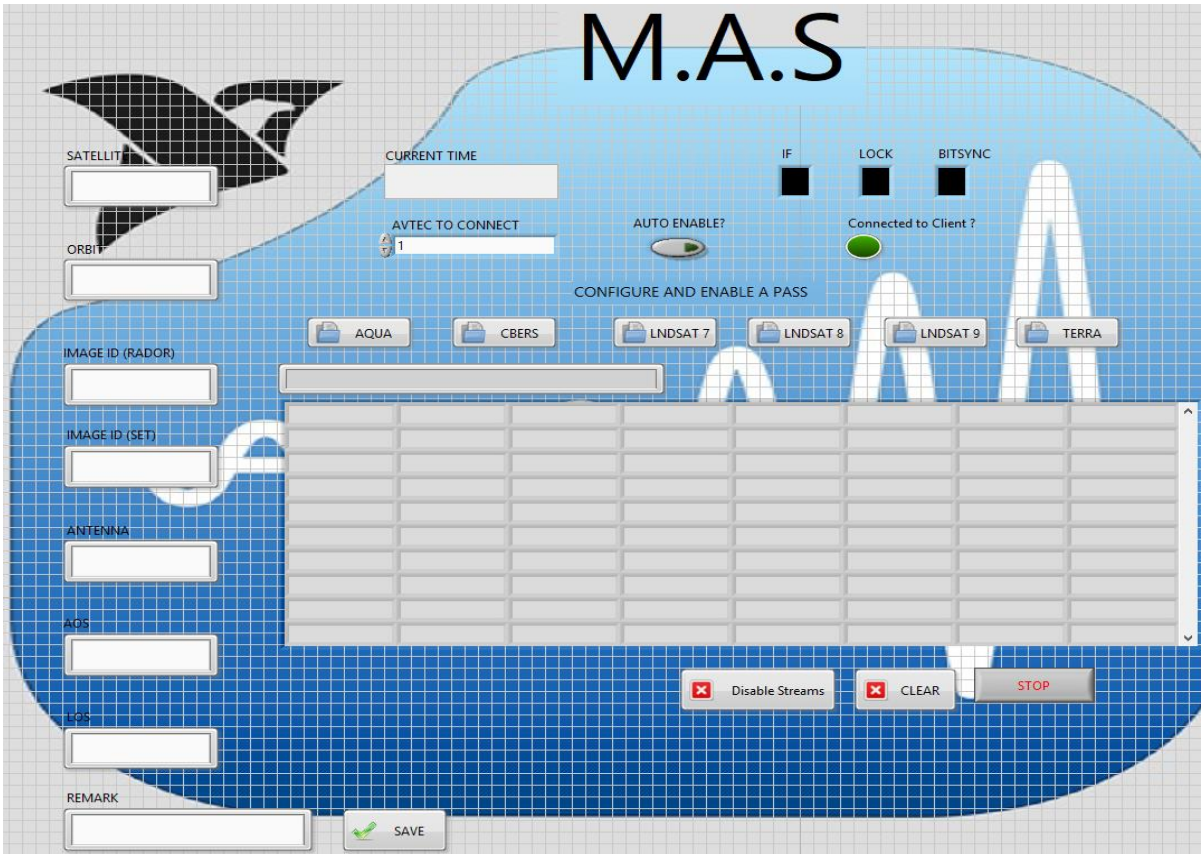
5. Future work-additions to the system

The system is called mission assistance software for a reason as it is a part of a big planned system that will automatically perform all tasks related to providing technical and support to space missions. A Monitoring and Controlling(M&C) system for LSX and 12m antennas is being developed. This will automatically set frequency, attenuation and other options users require on the down and up converters.

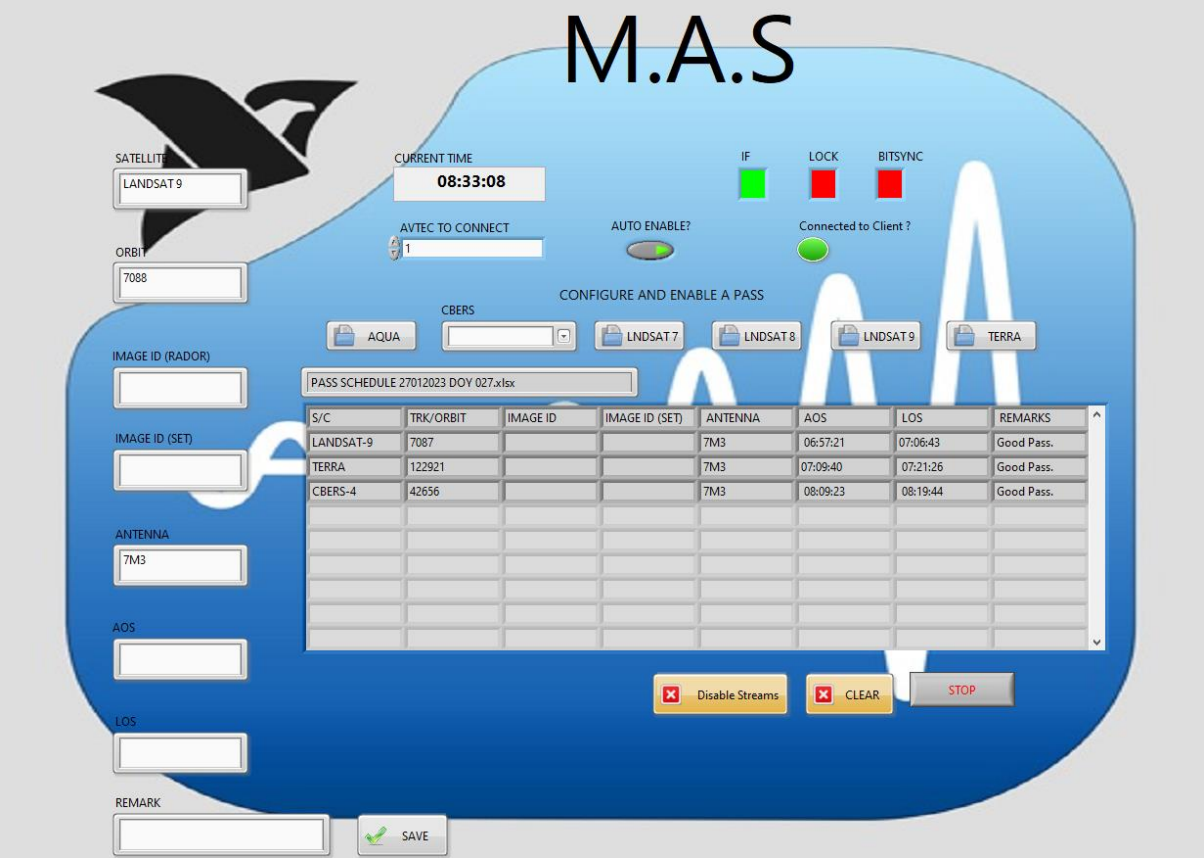
Another future functionality is that the matrix responsible for allocating demodulator to correct antenna will also be controlled through M.A.S as commands will also be sent automatically. More antennas are planned to be included on the system in the future with the aim \to reduce human error and company costs.

6. Conclusion

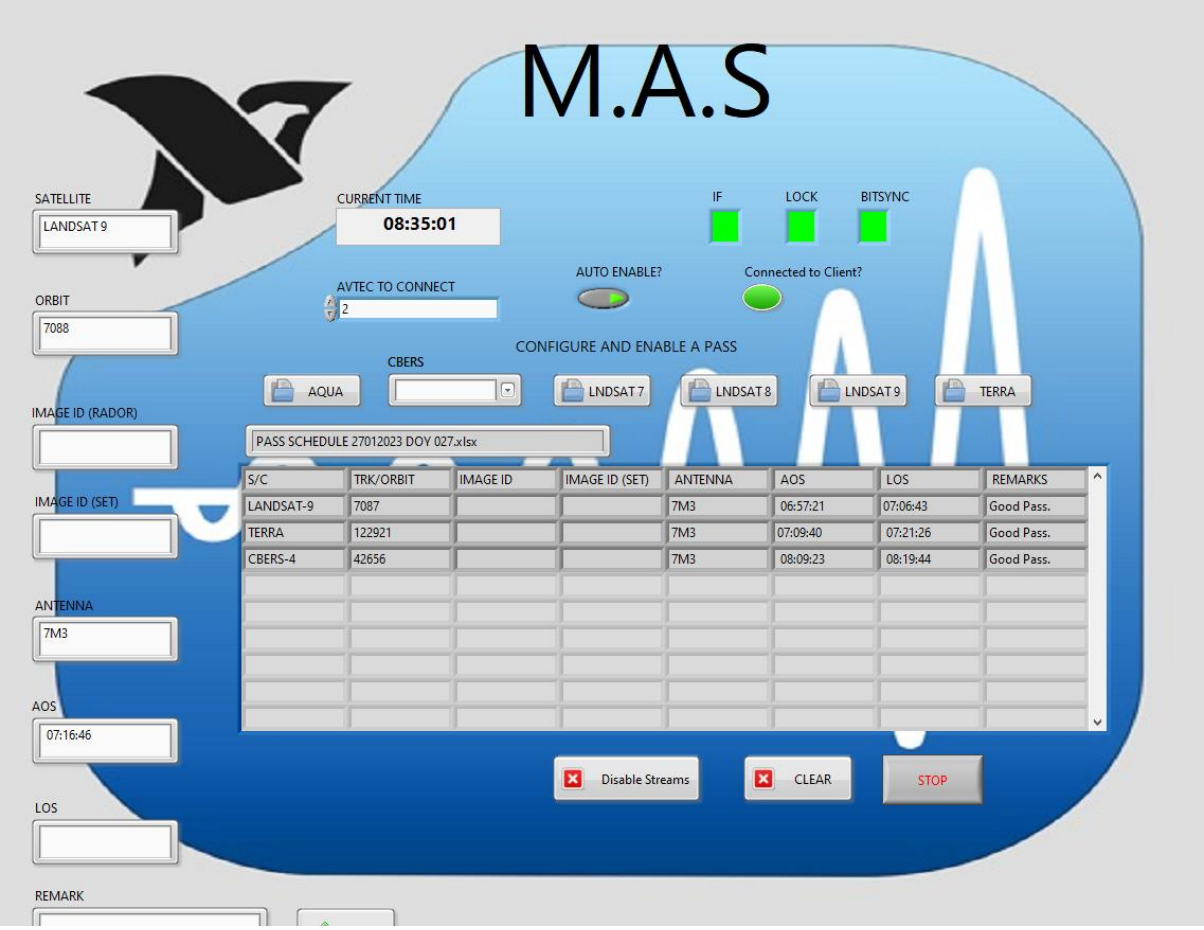
Key points noted would be, developing a system does not guarantee that it will be accepted and be used by the user, based on the point if the system is met with resistance or not used for some reasons as a developer , taking down the system sometimes is not the required solution. The developer must get to the root core of the problem by doing some research on figuring out the causes of the problems and solutions that works. In some cases users just choose to not use the system and based on this case study it has been realised that human factors are the actual push to developers for creating a fully automated systems.



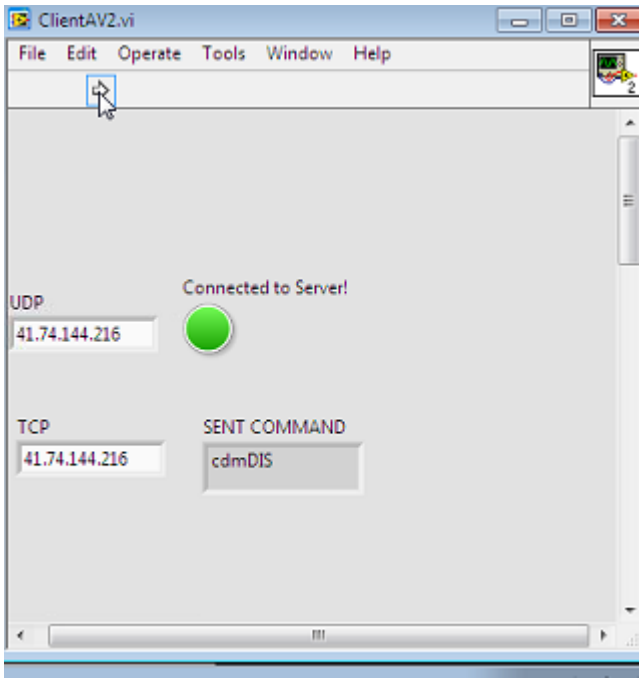
M.A.S NO CONNECTION



M.A.S LOS



M.A.S AOS AND THE CLIENT (SERVER AND CLIENT COMMUNICATION : CLIENT RUNNING ON THE DEMODULATOR)



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