

How to use Data Mining Processes and Techniques for Knowledge Transfer in Launch Mission Support

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Abstract

One of the factors that lead to successful missions is learning from experience. Post mission phase gives an opportunity to learn from the mission and to provide guidelines for future missions. Successes and failures identified can be documented as lessons learned and used to transfer knowledge to current and new workforce. During design and development phase of the spacecraft whereby subsystems are built and integrated into a single spacecraft, more knowledge is acquired, even so when it is being tested and launched into space. Similarly, there are preparations and tests done on the ground station to prepare for the launch mission. Rigorous reviews such as preliminary design review, critical design review, test readiness review, flight readiness review on the satellite as well as antenna readiness tests, dataflow tests, equipment configurations testing on the ground station to prepare for the launch, including all the time and effort that the team invest in ensuring a successful mission produces innumerable amount of knowledge and experience. It is when this knowledge acquired is not properly captured and transferred for continuous improvement that a space agency loses some of its intellectual capital. When this critical knowledge only resides in human brains and teams disintegrate, others transition from one program to another or retire, there is a huge knowledge gap left behind. Imagine the new knowledge created through data mining process resulting from assembly, testing and launch operations of a spacecraft. This can help the space industry to improve the supply of products and services, optimize operations, make technological advances and enhance customer satisfaction. Organizations can use data mining processes and techniques to extract valuable information during satellite mission design and launch support, identify patterns and trends, and convert it into useful knowledge.

The aim of this paper is to explore the suitability of data mining software in extracting insights from launch mission support data for the benefit of knowledge transfer and improving future mission support services.

Keywords: Knowledge Transfer, Launch Mission Data, Data Mining

1. Introduction

Organizations collect enormous amounts of data pertaining to services they provide to clients such as activities that take place during mission support, feedback from clients and other operations activities. This data contains potential insights that can optimize operations and create efficiency. Within this data, insights can be discovered that basic post-mission reports can't effectively reveal. By using the right tools, the insights can be extracted and turned into useful knowledge to further empower employees leading to enhanced customer satisfaction.

Every mission is unique. As the technical and operations team prepares for a launch mission support, there's information and knowledge generated that can provide insights to create new knowledge. Typical preparations include pre-launch tests such as antenna qualification tests, RF and connectivity tests, network tests and dataflow tests. All this information is stored in the organization's database.

There's an opportunity for this information to be analysed further and stored in a manner that assists in decision making, enhances preparations for future missions, and enables knowledge transfer. Data mining system enabled by artificial intelligence (AI) solution can provide advanced data analysis capabilities. The system can be used to extract performance trends and patterns and develop knowledge transfer roadmaps or guidelines.

This paper aims to explore the suitability of data mining software in extracting insights from launch mission support data for the benefit of knowledge transfer and improving support services in future missions.

2. Material and methods

2.1. Study Objectives

The point of departure for this study was to explore internal perceptions towards data mining processes. The study anticipated the development of a suitable data mining application with the purpose of facilitating knowledge transfer.

2.2. Research Instrument

To explore perceptions towards the establishment of data mining solutions within the company, a Questionnaire was developed and distributed to a target population of 66 staff members comprising researchers, scientists, remote sensing specialists, systems engineers, data and archive technicians and space weather forecasters. To develop a suitable data mining solution, coding scripts were developed and multiple simulations conducted.

2.3. Data Administration and Collection

Microsoft Forms application was used to distribute the questionnaire. The data sources used to test the exploratory study came from contacts located in different divisions in the organization. Qualitative and quantitative data was collected through the survey.

2.4. Data Analysis Method

Data was analysed using content analysis method where themes/categories/concepts were extracted from the data received. Insights functionality in Microsoft Forms was also used to categorize qualitative data. Though this system automatically allocated data categories, all categorized data was reviewed to confirm accuracy.

3. Theory and calculation

3.1. Literature Review

“Data mining is the process of extracting knowledge or insights from large amounts of data using various statistical and computational techniques. The data can be structured, semi-structured, or unstructured, and it can be stored in various forms such as databases, data warehouses, and data lakes” (Vaidya & Sharma, January 2025) [3].

Data mining tools can help organizations discover the hidden knowledge in the enormous amount of data they collect. “Data mining helps analysts recognize significant facts, relationships, trends, patterns, exceptions, and anomalies that might otherwise go unnoticed” (Shrivastava, 2023) [4].

“The future of space industries depends on the successful transfer of knowledge. Learning methods that facilitate a flexible learning environment are required to accommodate different generations of the current workforce. For instance, Generation Z is characterized by a strong commitment to digital technologies, a high affinity for collaboration, and a preference for interactive and visual learning methods. Unlike previous generations, Generation Z increasingly favours informal, flexible and context-based learning” (Wiesel, September 2023) [1].

“Professionals in mid- to late career stages who are considered part of the Baby Boomers generation are leaving the workforce while an even larger demographic, Millennials, have entered the workforce. The pace of the transition has resulted in many companies losing massive amounts of knowledge and struggling to operate at the same performance levels with a less experienced workforce” (Green, et al., January 2020) [2].

The process begins with collecting data from different sources and storing it in data warehouses or data lakes locally and in a secure online storage space for backup, cleaning the data to remove random noise and errors from the data, addressing discrepancies in the data, detecting unusual data points that might skew the results, replacing missing data with appropriate values, integrating the data by combining datasets from different databases or files and ensuring that the data from different sources is in a consistent format and scale, transforming the data into suitable format for analysis e.g. converting text data into numerical data and scaling it to a specific range then converting continuous data into discrete values, reducing the data by sampling and compressing the data while preserving its essential features, partitioning the dataset by splitting it into training, validation and testing sets. So, this process ensures that the data is clean, consistent and suitable for building accurate and reliable models for analysis.

To extract meaningful information from this data, there are several types of data mining techniques that can be used namely:

Data Visualization – Represents data visually using charts, graphs and other visual aids. e.g. creating dashboards for website traffic, equipment performance etc.

Prediction – Forecasting future values based on historical data. e.g. Predicting future trends and patterns based on historical data.

Anomaly Detection – Identifying items or events that deviate from an expected pattern. e.g. detecting anomalies that occurred during launch mission support.

Regression – Modelling a relationship between a dependent variable and one or more independent variables.

Classification - Categorizing data objects into predefined classes or groups.

Clustering – Grouping similar data points together based on their features.

Association Rule Mining – Discovering relationships between different items or events in a dataset.

Neural Networks – Machine learning models inspired by the structure and function of human brain.

Decision Trees - A flowchart-like structure that uses a series of decisions to classify or predict an outcome.

In this study the datamining processes and tools/techniques are used to search post – mission reports and analyze trends and patterns, performance, give recommendations and conclusion as well as the knowledge that can be transferred to the workforce and the tools that can be used to transfer this newfound knowledge.

“Many different fields use data mining techniques for technical, commercial, and research purposes” (Shrivastava, 2023) [4]. In the space industry many departments can use data mining techniques for business development, preventative maintenance, project management, Safety Health Environment and Quality (SHEQ) as well as Information communications technology (ICT).

4. Results

A survey was distributed to a sample population of sixty-six (66) participants in different divisions within SANSa. A response rate of 34,8% was achieved. The target population was from earth observation and space science only.

4.1. Demographical Data

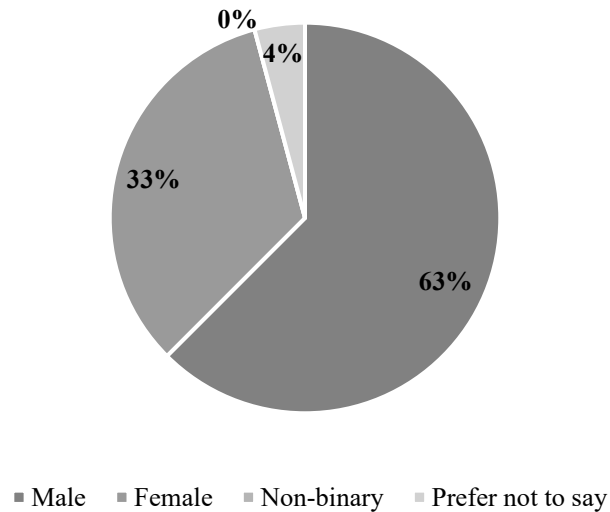


Figure 1: Response rate by gender

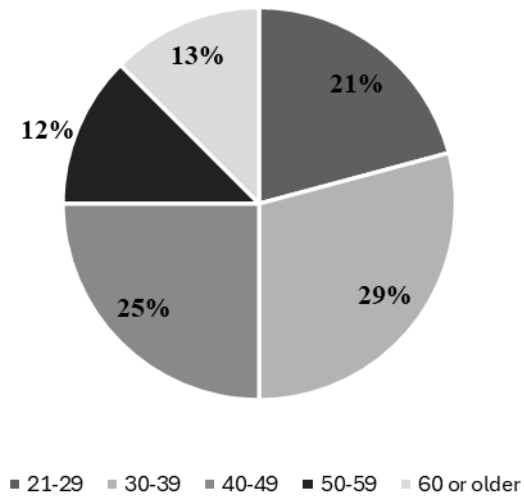


Figure 2: Response rate by age

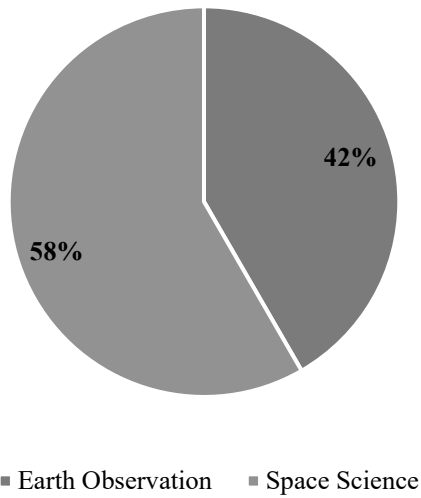


Figure 3: Divisions in the Organization

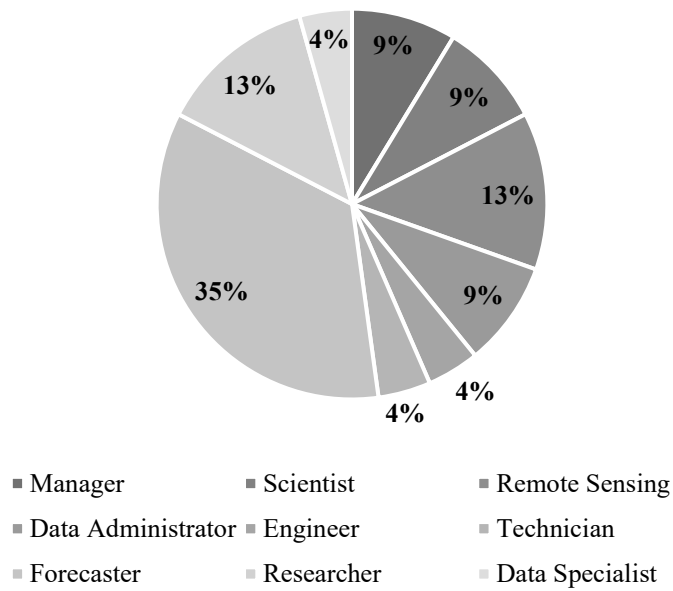


Figure 4: Designation

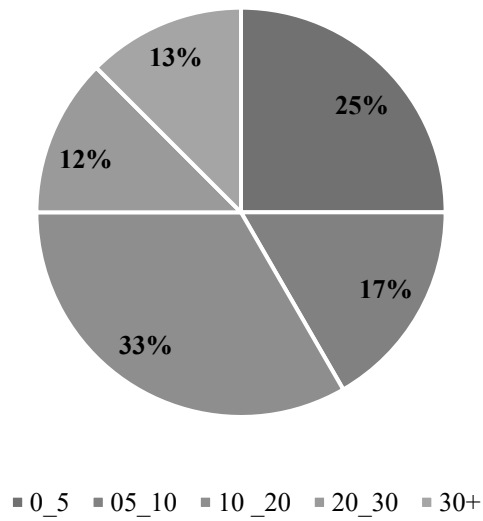


Figure 5: Work Experience

4.2. Results per survey topic

Question #1: Are your processes of analysing data efficient?

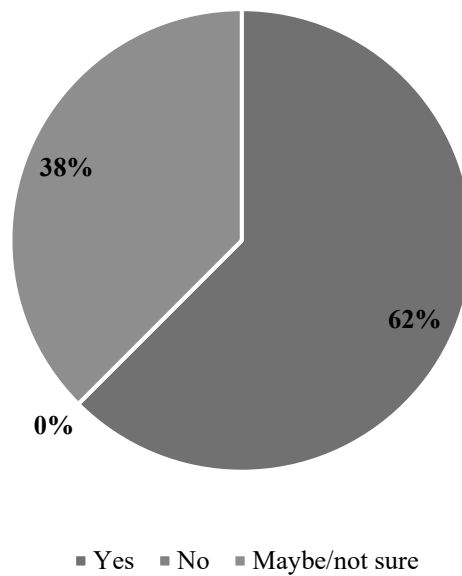


Figure 6: Efficiency of the process to analyze data

Question #2: Is the current system/software efficient to process and store data?

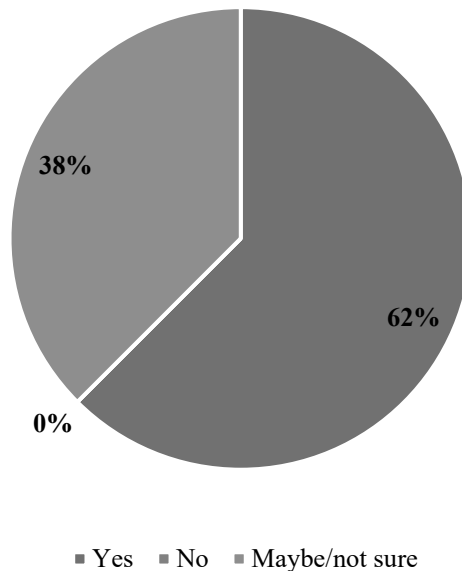


Figure 7: System/Software Efficiency

Question #3: Can SANSa use data mining processes and techniques to analyse data

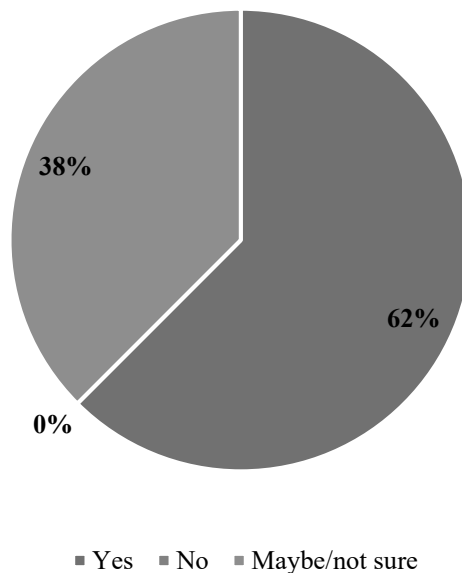


Figure 8: Data Mining techniques to analyze data

The findings indicated that most of the respondents believe that their current processes, systems and software are efficient to process, analyze and store data and that SANSa can use data mining processes and techniques to analyze data further. The respondents highlighted that the software suitable for data mining will vary depending on the data to be extracted and analyzed while python data mining software would be ideal for this purpose depending on which package the organization chooses. The process of mining and analyzing data using python software and AI solutions is shown below:

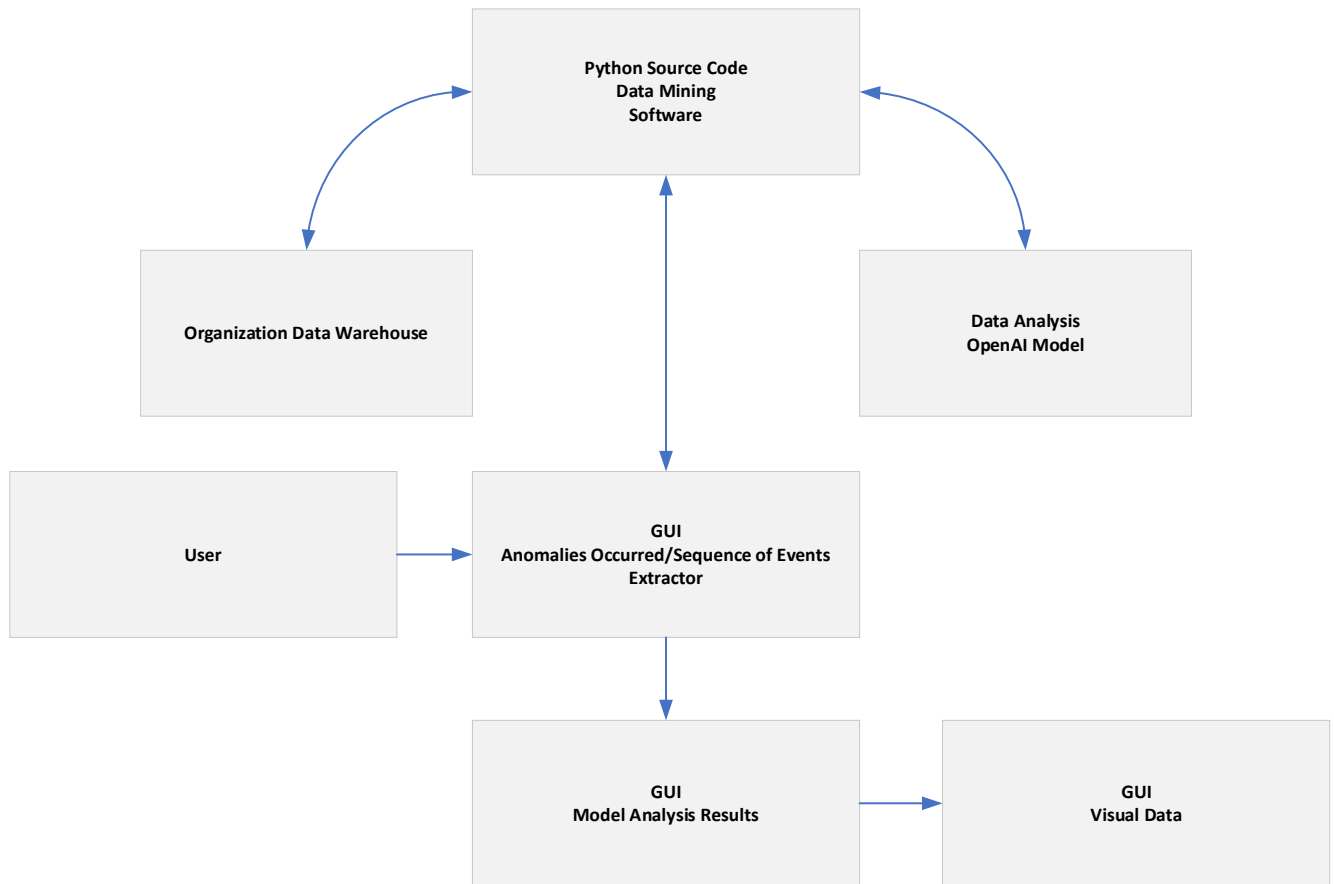


Figure 9: Process of Data Mining and Analysis using Open AI Model

The diagram above shows the process of transferring knowledge to the workforce using python data mining and analysis software. The python script searches, reads and extracts the required data from the post-mission reports stored in the organization’s data warehouse and displays it on the Graphical User Interface (GUI) as either anomalies occurred or sequence of the events. The user then runs analysis of the extracted data displayed on the GUI by clicking the analysis tab on the GUI and the GUI sends the command to the python script which then prompts the OpenAI model to analyse the data. The model analyses trends and patterns, performance, recommendations and conclusion as well as the knowledge to be transferred to the workforce and the tools to be used to transfer this newfound knowledge from the extracted data and then sends the analysed text data to the python script which will then be displayed on a separate GUI as model analysis results. The results of the analysis can be used to identify areas of improvement in operational and system controls, overall system review and upgrade, maintenance of equipment to improve/enhance performance as well as identifying knowledge gaps, skills development through personnel training to eliminate human errors. All this newfound knowledge can then be transferred to the workforce using knowledge transfer tools such as presentations, user manuals, maintenance handbooks, video tutorials, podcasts and standard operating procedures (SOP’s) etc.

When the software is run, the GUI window pops-up to provide the *option of* choosing the file path of the company database i.e. where relevant documents are stored and to search either *by* client name, satellite name, and antenna name, date range and which data to display either anomalies occurred or sequence of events. The search reports button is used to search the reports depending on the date range and the type of data required whereby the software reads each file from the selected file path to extract the data required. Progress bar is displayed when searching the reports to show the number of files being searched. The extracted data then displays at the bottom of the GUI. Once the data has been extracted, the run analysis tab prompts the AI model to analyse the extracted data. Running analysis by clicking run analysis tab, a separate pop-up window (second GUI) displays on the screen containing the analysed text data that shows trends and patterns, performance, recommendations and conclusion, the knowledge to be transferred to the workforce, as well as knowledge transfer tools/guidelines/map and the option to save the results on the organization’s database. On the second GUI that has the results of the analysis, there is another tab to generate visual data from the

analysed text data. Generating visual data by clicking generate visuals tab, the analysed text data is now displayed as visual data such as graphs, charts, images etc.

The software is divided into a few sections that include the script for the GUI, three models to analyse the extracted data, i.e. pre-coded model, stableLM and OpenAI. The simulation can either be run by any of the three models. Currently the software is connected to the OpenAI model. The model uses API key, and tokens must be purchased depending on which version of the model has been chosen. Once tokens are purchased, the credit balance is allocated and every time the model is run to analyse the data during simulation of the python code, charges are incurred and deducted from the credit balance. The charges are not fixed, it all depends on the amount of data extracted that needs to be analysed, the more data to be analysed the more charges incurred.

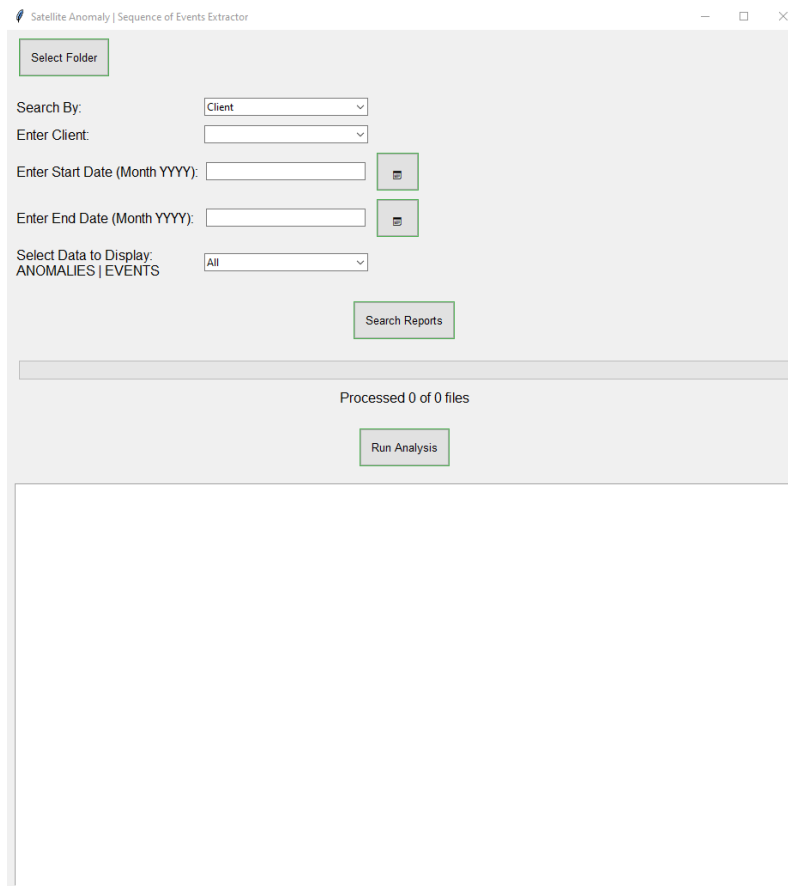


Figure 10: Running the python code

Satellite Anomaly | Sequence of Events Extractor

Select Folder: D:/Data Mining/SpaceOps2025/Data Mining/Data Sets/Data/Signed/Signed Reports

Search By: Client

Enter Client: telesat

Enter Start Date (Month YYYY): January 2018

Enter End Date (Month YYYY): March 2025

Select Data to Display: ANOMALIES | EVENTS

Search Reports

Processed 191 of 191 files

Run Analysis

Matching Reports:

File: Post Support report DSN 3.pdf

Report Compiled: 15 November 2024
Client Name: Telesat
Satellite Name: DSN-3
Antenna Used: Unknown
Frequency Band: Ku-band

SUPPORT ANOMALIES:
Telesat lost connection to their equipment at the HBK site @ 10:08UTC on 05 November 2024.
IPS 2 went down due to multiple prefixes from the HBK network, which were flagged as anomalies. As a result, the ISP routers rejected all prefixes advertised by HBK, causing internet traffic to and from HBK to be dropped. Telesat was unable to connect to ISP 1 as well, HBK found that there were no connections on the Firewalls for ISP 1, made the connections and at the same time ISP 2 was restored, connection from HBK to Ottawa was restored at 12:14UTC.

File: Post Support report QZS-6.pdf

Report Compiled: 11 February 2025
Client Name: Telesat
Satellite Name: QZS-6
Antenna Used: Unknown
Frequency Band: Ku-band

SUPPORT ANOMALIES:

Figure 11: Anomalies Data extracted from the reports searched by client name

The image shows a window titled "Model Analysis Results" with standard window controls (minimize, maximize, close) in the top right corner. The content is organized into several sections:

- Trends and Patterns:**
 1. The satellite equipment seems to be encountering frequent disruptions, particularly involving connections to the HBK site and issues with ISP routers rejecting prefixes.
 2. The connection loss tends to create a ripple effect, as seen from the blocking of all internet traffic, and the effort required to restore the operations.
 3. The ACU seems to have an issue that was resolved by rebooting and reorienting it to the Satellite.
- Performance:**
 1. The team handling the abnormalities are quick in troubleshooting and handling the issues. Connection loss to the HBK site was resolved within approximately two hours.
 2. A common solution deployed in the scenarios shared is restoring/rebooting the systems.
 3. The issues seem to be repeated, perhaps indicating that there may be an underlying more significant, unresolved problem that is causing these anomalies.
- Recommendations:**
 1. In-depth investigation into why the issues are repeating needs to be conducted, making sure that it isn't just the symptoms being addressed but the actual root cause.
 2. Backup systems need to be placed to ensure smooth functioning in case of disconnections.
 3. A more systematic approach can be adopted to prevent the issues from happening in the first place, like advanced network monitoring and usage of tools to detect anomalies faster.
 4. Also, it's crucial to conduct training and upskill sessions on critical networks and systems for staff to better handle such situations.
- Conclusion:**

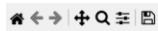
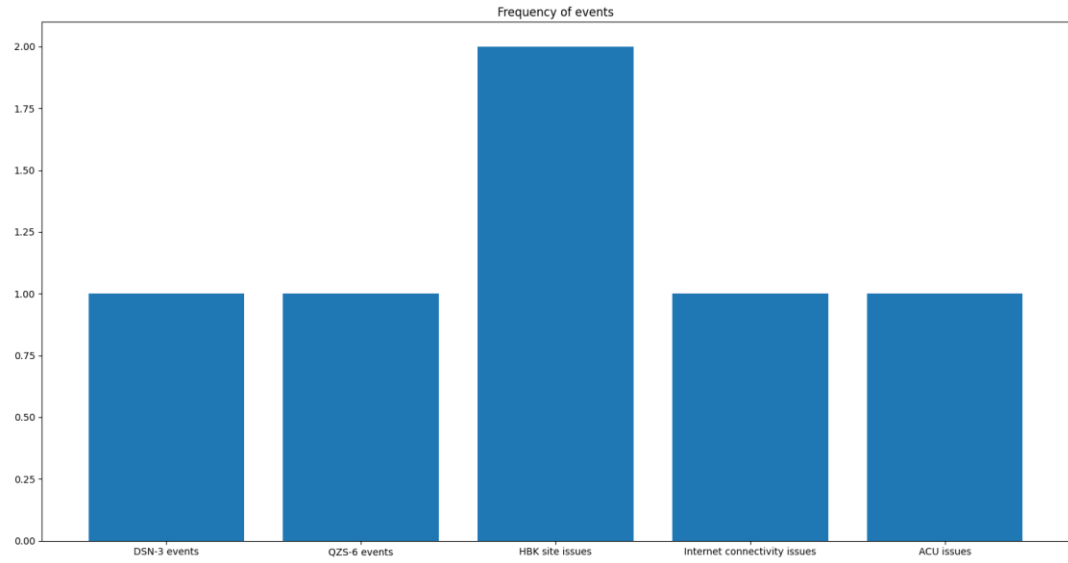
Overall, the key issues appear to be centered around connectivity, with fixes appearing to be temporary. Addressing the root issue will likely improve the consistency and reliability of service, reducing the need for frequent costly downtime and disruption to customer services.
- Transferring knowledge:**

To transfer knowledge to the workforce, encourage teams who handled the anomalies to share their experiences, troubleshooting steps, and learnings. These can be turned into case studies and used in training sessions. Regular workshops, seminars, mentoring

At the bottom of the window, there are three buttons: "Save Analysis", "Generate Visuals", and "Close".

Figure 12: Analyzed Data

Figure 1



(x, y) = (DSN-3 events, 1.356)

Figure 1

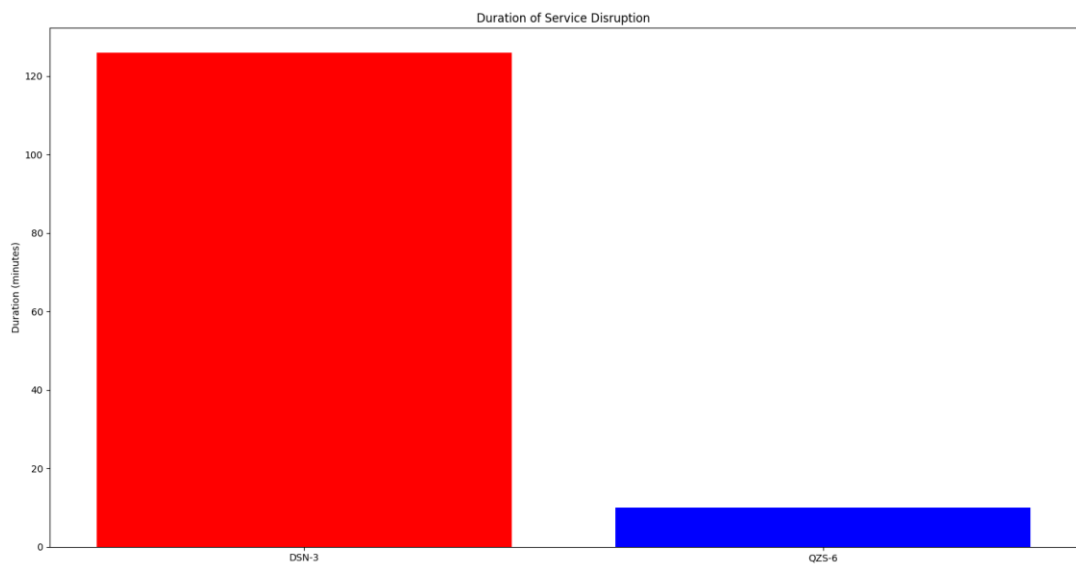
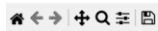
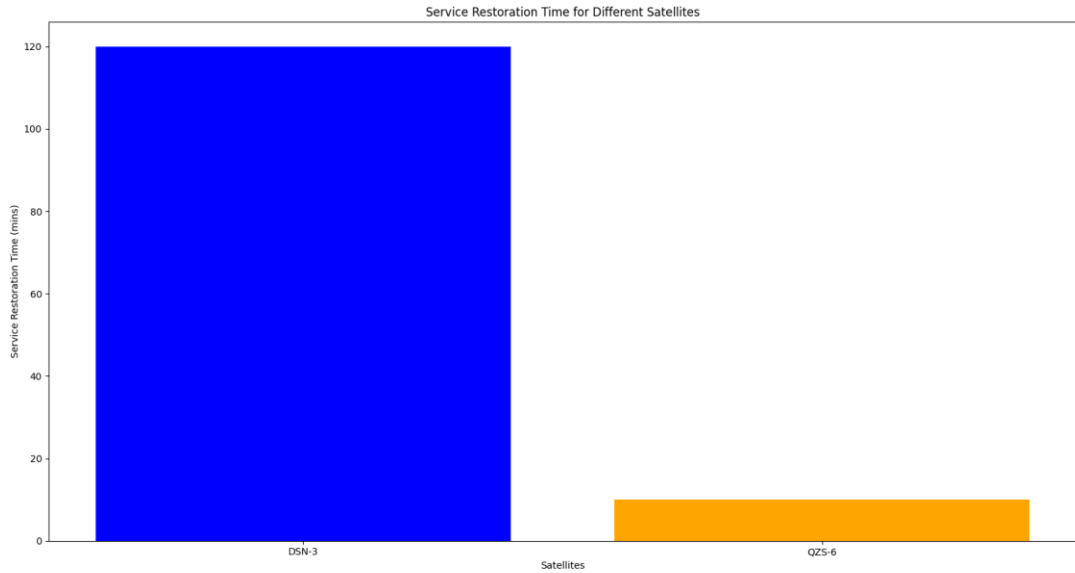


Figure 1



(x, y) = (DSN-3, 93.3)

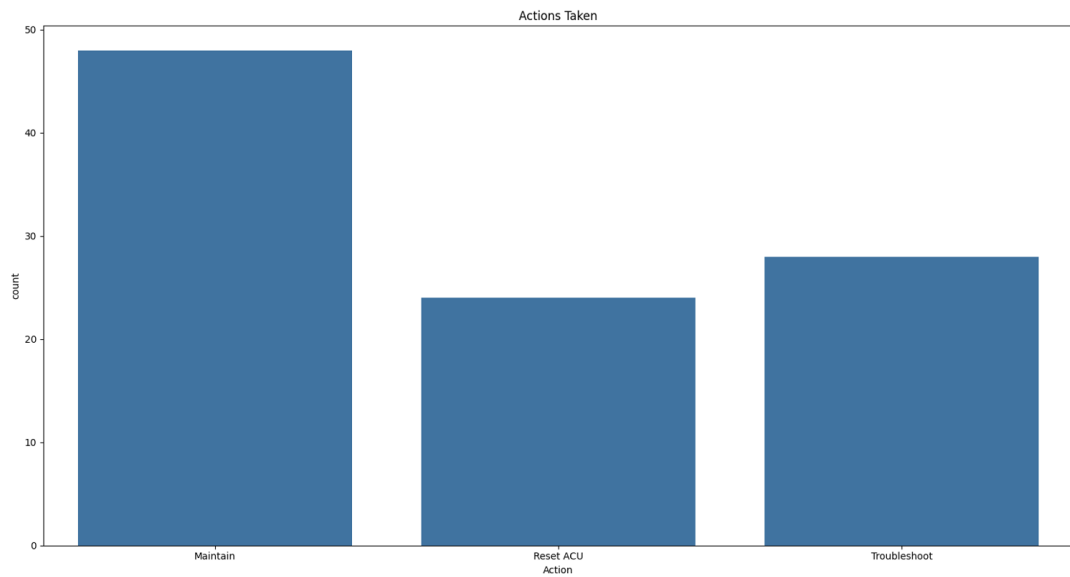


Figure 13: Visual Data generated from the results of the Analysis

Model Analysis Results
— □ ×

Trends and Patterns:

- The satellite equipment seems to be encountering frequent disruptions, particularly involving connections to the HBK site and issues with ISP routers rejecting prefixes.
- The connection loss tends to create a ripple effect, as seen from the blocking of all internet traffic, and the effort required to restore the operations.
- The ACU seems to have an issue that was resolved by rebooting and reorienting it to the Satellite.

Performance:

- The team handling the abnormalities are quick in troubleshooting and handling the issues. Connection loss to the HBK site was resolved within approximately two hours.
- A common solution deployed in the scenarios shared is restoring/rebooting the systems.
- The issues seem to be repeated, perhaps indicating that there may be an underlying more significant, unresolved problem that is causing these anomalies.

Recommendations:

- In-depth investigation into why the issues are repeating needs to be conducted, making sure that it isn't just the symptoms being addressed but the actual root cause.
- Backup systems need to be placed to ensure smooth functioning in case of disconnections.
- A more systematic approach can be adopted to prevent the issues from happening in the first place, like advanced network monitoring and usage of tools to detect anomalies faster.
- Also, it's crucial to conduct training and upskill sessions on critical networks and systems for staff to better handle such situations.

Conclusion:
 Overall, the key issues appear to be centered around connectivity, with fixes likely improve the consistency and reliability of service, reducing the need for emergency services.

Transferring knowledge:
 To transfer knowledge to the workforce, encourage teams who handled the incidents and learnings. These can be turned into case studies and used in training and sharing sessions can be organized to ensure the efficient learning and

Success
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Analysis saved and converted to PDF: D:/Data Mining/SpaceOps2025/Data Mining/Data Sets/Analysis logs/Analysis Logs 2/Test Data/Analysis_Log_2025-05-16 10-01-44.pdf

OK

Save Analysis

Generate Visuals

Close

Figure 14: Option to save the Analysis for future reference

Name	Date modified	Type	Size
Analysis_Log_2025-05-12-08-34	15/05/2025 11:44	Microsoft Word...	28 KB
Analysis_Log_2025-05-12-10-57	15/05/2025 11:43	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-10-20	15/05/2025 11:43	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-16-19	15/05/2025 11:42	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-19-42	15/05/2025 11:42	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-11-25	15/05/2025 11:42	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-11-24-21	15/05/2025 11:42	Microsoft Word...	28 KB
Analysis_Log_2025-05-13-11-21-25	15/05/2025 11:37	Microsoft Word...	28 KB
Analysis_Log_2025-05-14-08-37-52	14/05/2025 16:04	Microsoft Word...	30 KB
Analysis_Log_2025-05-14-08-15-12	14/05/2025 16:15	Microsoft Word...	31 KB
Analysis_Log_2025-05-14-10-16-19	14/05/2025 16:26	Microsoft Word...	31 KB
Analysis_Log_2025-05-14-10-40-25	14/05/2025 16:40	Microsoft Word...	31 KB
Analysis_Log_2025-05-14-10-46-06	14/05/2025 16:49	Microsoft Word...	30 KB
Analysis_Log_2025-05-14-10-36-11	14/05/2025 16:59	Microsoft Word...	31 KB
Analysis_Log_2025-05-14-11-53-35	14/05/2025 17:03	Microsoft Word...	30 KB
Analysis_Log_2025-05-14-11-16-57	14/05/2025 17:09	Microsoft Edge P...	4 KB
Analysis_Log_2025-05-14-11-30-45	14/05/2025 17:10	Microsoft Edge P...	3 KB
Analysis_Log_2025-05-14-11-38-30	14/05/2025 17:18	Microsoft Word...	30 KB
Analysis_Log_2025-05-14-11-47-56	14/05/2025 17:48	Microsoft Word...	28 KB
Analysis_Log_2025-05-14-14-31-085	14/05/2025 17:48	Microsoft Word...	30 KB
Analysis_Log_2025-05-17-11-51-51	17/05/2025 17:12	Microsoft Word...	30 KB
Analysis_Log_2025-05-17-11-51-51	17/05/2025 17:12	Microsoft Edge P...	17 KB
Analysis_Log_2025-05-18-19-23-82	18/05/2025 19:23	Microsoft Word...	30 KB
Analysis_Log_2025-05-19-19-23-82	19/05/2025 19:23	Microsoft Edge P...	16 KB
Analysis_Log_2025-05-19-19-23-82	19/05/2025 19:23	Microsoft Word...	30 KB
Analysis_Log_2025-05-19-19-38-34	19/05/2025 19:38	Microsoft Edge P...	16 KB
Analysis_Log_2025-05-20-09-15-12	20/05/2025 09:15	Microsoft Word...	28 KB
Analysis_Log_2025-05-20-09-15-12	20/05/2025 09:15	Microsoft Edge P...	10 KB
Analysis_Log_2025-05-22-07-52-12	22/05/2025 07:52	Microsoft Word...	30 KB
Analysis_Log_2025-05-22-07-52-12	22/05/2025 07:52	Microsoft Edge P...	17 KB
Analysis_Log_2025-05-22-19-28-20	22/05/2025 19:28	Microsoft Word...	30 KB
Analysis_Log_2025-05-22-19-28-20	22/05/2025 19:28	Microsoft Edge P...	17 KB
Analysis_Log_2025-05-23-08-58-48_Summary	23/05/2025 08:58	Microsoft Word...	102 KB
Analysis_Log_2025-05-27-11-40-19	27/05/2025 11:40	Microsoft Edge P...	100 KB
Analysis_Log_2025-05-27-11-40-19	27/05/2025 11:40	Microsoft Edge P...	98 KB
Analysis_Log_2025-05-27-19-11-38	27/05/2025 19:11	Microsoft Edge P...	100 KB
Analysis_Log_2025-05-27-19-20-58	27/05/2025 19:21	Microsoft Edge P...	100 KB
Analysis_Log_2025-05-28-10-48-10	09/06/2025 10:48	Microsoft Edge P...	91 KB

Figure 15: Option to choose a file path to save the analysis for future reference

Analysis of Anomalies Occurred

Analysis:

There were significant connectivity issues with the Telesat DSN-3 and QZS-6 satellites, specifically with internet traffic and Antenna Control Unit (ACU) of the respective satellites.

Trends and Patterns:

1. There is a recurring trend of communication issues with Telesat’s satellites DSN-3 and QZS-6.
2. These anomalies seem to stem from issues with internet service providers (ISP1 & ISP2), network prefixes, and the Antenna Control Unit.

Performance:

1. The response time in both incidents was reasonably quick. In the DSN-3 satellite incident, restoration of the connection took approximately 2 hours. For the QZS-6 satellite, the corrective action (ACU reboot) was initiated and completed within 10 minutes.

Recommendations:

1. Review the end-to-end connection frameworks and consider running periodic maintenance checks to identify and resolve any potential anomalies early.
2. Enhance the training of onsite IT personnel and provide them with deeper understanding of satellite communications and network management.
3. Develop a protocol for system reboots and connection restoration to minimize the time of system downtime.

Transferring Knowledge to the workforce:

The findings of this analysis can be invaluable in refining the skill sets of employees. The information can be incorporated into a training curriculum or can be conveyed through a workshop, with focus on examples of real-life anomalies, their impact, and their resolutions. This will add a practical dimension to their theoretical understanding, enabling them to better respond to similar situations in future.

Conclusion:

Although response to the issues was swift, preventive maintenance and regular system checks might prevent recurrence of such issues. Enhancing the knowledge and skill set of the workforce can assist in this regard.

Roadmap for Knowledge Transfer to Workforce:

Step 1: Define Objectives:

Start by explicitly defining what knowledge needs to be transferred to the workforce. In this scenario, the objective would be to enhance the employee’s understanding and capabilities

Figure 16: Analysis saved in PDF format

File: PSR ADRAS-J Routine - May 2024_2nd version signed.pdf

Report Compiled: 18 June 2024
Client Name: Scs
Satellite Name: ADRAS-J ROUTINE
Antenna Used: Unknown
Frequency Band: S-band

SUPPORT ANOMALIES:
Ten passes with various issues are indicated on table 1 under support schedule. Eighty-two passes out of ninety-two were delivered successfully. All passes with low data rate and bad frames are removed from anomalies list.

File: PSR ADRAS-J Routine - April 2024_second version signed.pdf

Report Compiled: 06 May 2024
Client Name: Ksat
Satellite Name: ADRAS-J ROUTINE
Antenna Used: Unknown
Frequency Band: S-band

SUPPORT ANOMALIES:
5.1 Anomaly description
No S-band TM during the pass.
5.1.1 Date and time
04 April 2024 at 14:43z

Figure 17: Extracted Data searched by satellite name

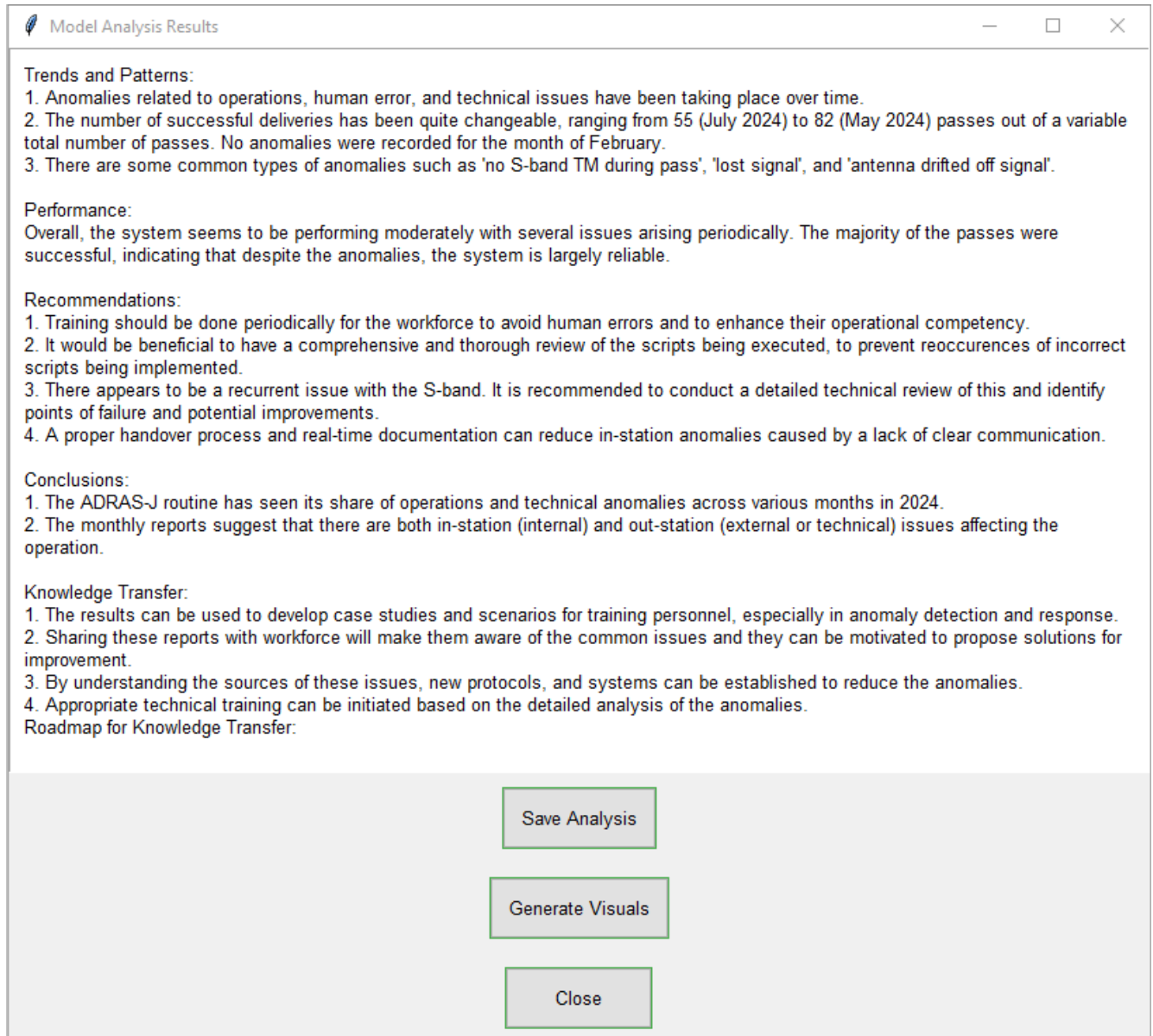


Figure 18: Analyzed Data searched by satellite name

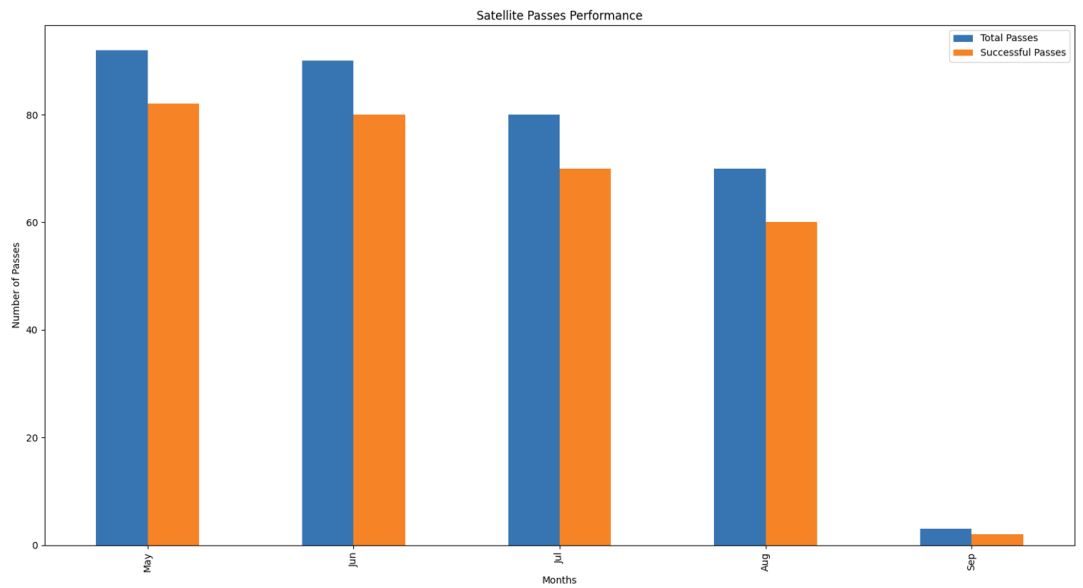
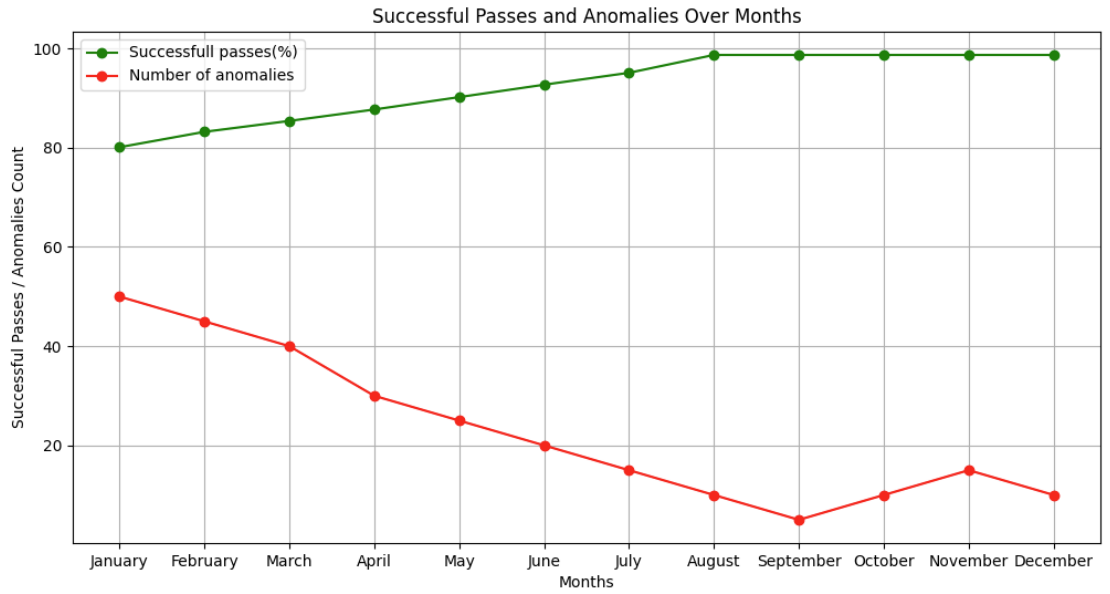
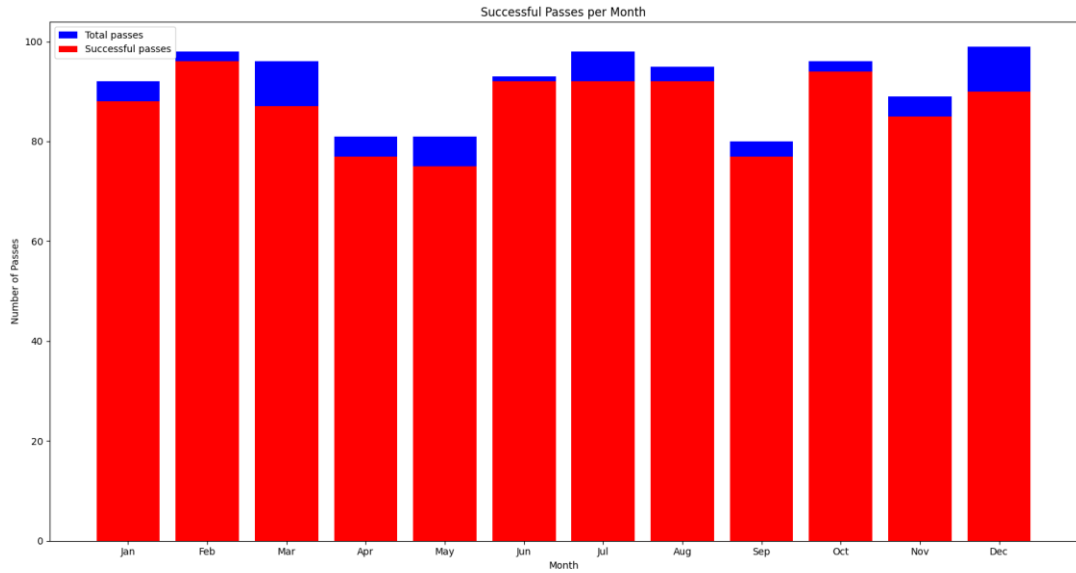


Figure 1



Navigation icons: Home, Back, Forward, Zoom In, Zoom Out, Full Screen, Print

(x, y) = (Feb, 69.8)

Figure 19: Visual Data generated from the results of the Analysis searched by satellite name

Model Analysis Results

Trends and Patterns:

1. Anomalies related to operations, human error, and technical issues have been taking place over time.
2. The number of successful deliveries has been quite changeable, ranging from 55 (July 2024) to 82 (May 2024) passes out of a variable total number of passes. No anomalies were recorded for the month of February.
3. There are some common types of anomalies such as 'no S-band TM during pass', 'lost signal', and 'antenna drifted off signal'.

Performance:

Overall, the system seems to be performing moderately with several issues arising periodically. The majority of the passes were successful, indicating that despite the anomalies, the system is largely reliable.

Recommendations:

1. Training should be done periodically for the workforce to avoid human errors and to enhance their operational competency.
2. It would be beneficial to have a comprehensive and thorough review of the scripts being executed, to prevent reoccurrences of incorrect scripts being implemented.
3. There appears to be a recurrent issue with the S-band. It is recommended to conduct a detailed technical review of this and identify points of failure and potential improvements.
4. A proper handover process and real-time documentation can reduce in-station anomalies caused by a lack of clear communication.

Conclusions:

1. The ADRAS-J routine has seen its share of operations and technical anomalies across various months in 2024.
2. The monthly reports suggest that there are both in-station (internal) and out-station (external) anomalies during each operation.

Knowledge Transfer:

1. The results can be used to develop case studies and scenarios for training.
2. Sharing these reports with workforce will make them aware of the common issues and potential improvements.
3. By understanding the sources of these issues, new protocols, and standard operating procedures can be developed.
4. Appropriate technical training can be initiated based on the detailed analysis.

Roadmap for Knowledge Transfer:

Success

Analysis saved and converted to PDF: D:/Data Mining/SpaceOps2025/Data Mining/Data Sets/Analysis logs/Analysis Logs 2/Test Data/Analysis_Log_2025-05-16 10-29-49.pdf

OK

Save Analysis

Generate Visuals

Close

Figure 20: Option to save the Analysis for future reference

The screenshot shows a Windows File Explorer window with the following path: This PC > DATA (D:) > Restore > kmbuyisa > bbbbbb > biblical > KENYA > Knowledge > SpaceOps2025 > Data Mining > Data Sets > Analysis logs > Analysis Logs 2. The main pane displays a list of files with columns for Name, Date modified, Type, and Size.

Name	Date modified	Type	Size
Analysis_Log_2025-04-04 12-08-24	04/04/2025 12:08	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-09-19	04/04/2025 12:09	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-14-14	04/04/2025 12:14	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-50-07	04/04/2025 12:50	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-50-56	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-51-30	04/04/2025 12:51	Microsoft Word Doc...	38 KB
Analysis_Log_2025-04-04 12-51-30	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB

Figure 21: Option to choose a file path to save the analysis for future reference

Analysis of Anomalies Occurred

Trends and Patterns:

1. The use of the S-band frequency is constant across all months.
2. The main contributor to anomalies is "human error": incorrect script execution, unscheduled changes to configuration, misunderstanding of requests, and scheduling errors.
3. Anomalies related to technology or on-site issues are also prevalent, such as errors related to signal tracking, signal loss, antenna issues, and undetermined causes.
4. The percentage of successfully delivered passes varies from month to month, but there is an observable trend of at least 76% success rate.

Performance:

1. The PSR ADRAS-J Routine's performance demonstrates consistent attempts to achieve successful pass delivery.
2. Although there are regular anomalies, most of these are either corrected or unable to be reproduced.
3. Despite these efforts, some anomalies remain unable to be determined, and it appears that this uncertainty has not been reduced over time.

Recommendations:

1. Foster continual training and regular reminders for staff to minimize human error.
2. Invest in further investigation into the repeated anomalies of unknown cause to work towards mitigation strategies.
3. Systematically review technological aspects that present consistent problems, for example, signal loss, antenna functionality, etc.
4. Implement better scheduling systems or checks to avoid missed opportunities due to scheduling errors.

Conclusion:

The ADRAS-J routine has shown consistent usage of S-band frequency, maintaining a steady level of successful passes despite repeated anomalies. The most common cause of these issues is human error, with technology faults also playing a significant role. Recommending continual training and system reviews, it's feasible to think that the instances of anomalies could be significantly reduced.

Transferring knowledge:

Figure 22: Analysis saved in PDF format

File: Post Support report IM-1-signed.pdf

Report Compiled: 28 March 2024
Client Name: Intuitive machines
Satellite Name: IM-1
Antenna Used: 12m
Frequency Band: S-band

SEQUENCE OF EVENTS:
02/12/2023 02:20 12M/26M LRO Test support
CdO/ Jonathan 02:22 12M configured and setup for RNG CAL
03:00 Start of de-brief
03:20 RNG cal to start soon. Took 26m off point
03:55 RNG completed with Goddard. HBK to start with
03:58 RNG signal and modulation observed. Signal very
high. Increased UIC1 ATT
04:04 Carrier down for RNG
04:06 HBK could hear everyone on the comms, but no
one could hear us. Dropped the connection and
04:06 AOS on 26m
04:06 AOS on 12m
04:13 C/U on 12m. EIRP 63.5 dBW radiated.
04:24 Carrier down
04:33 End of LRO test support. EIRP level from HBK
was sufficient.
04:40 Debrief on Webex.

Figure 23: Extracted sequence of events Data searched by antenna name

Model Analysis Results

Trends and Patterns:

1. Throughout the report, it is observed that calibration processes for the RNG and LRO testing were frequently conducted and generally successful.
2. Several instances of signal issues, including low but stable signal or brief signal loss were reported.
3. Notably, there were instances where the HBK2 axis stopped moving and programming was restarted.

Performance:

1. Both the 12m and 26m antennas were utilized throughout the processes, proving instrumental in testing and calibration efforts.
2. There were multiple instances where the HBK2 axis stopped moving which could have hindered operations.
3. The communication between the team members seemed effective and prompt which helped in troubleshooting and decision-making.

Recommendations:

1. Investigate the frequent stopping of the HBK2 axis to prevent future interruptions to processes.
2. To counteract the issue of signal drop-outs and low signals, potential equipment upgrades or additional support mechanisms could be considered.
3. Routines and protocols could be reviewed and revised to ensure that all the steps are properly conducted and all the instruments are well set-up to decrease the chances of anomalies occurring.

Conclusion:

The report details a series of tests and operations carried out using 12m and 26m antennas. Despite some minor issues, it appears that operations were conducted successfully indicating an effective team and robust systems.

Knowledge Transfer:

The knowledge from this analysis can be transferred to the workforce through a series of training sessions using this report as a real-world example. Key operational processes can be highlighted, as well as an emphasis on troubleshooting skills based on the anomalies that arose. Additional focus could be placed on the importance of effective communication and collaboration, as indicated by the report, to support process efficiency.

Tools for Knowledge Transfer:

1. Training Seminars: These are an effective way to educate staff on new concepts and practices. In this case, seminars can use the report as a case study to discuss problem-solving, teamwork, and equipment usage.

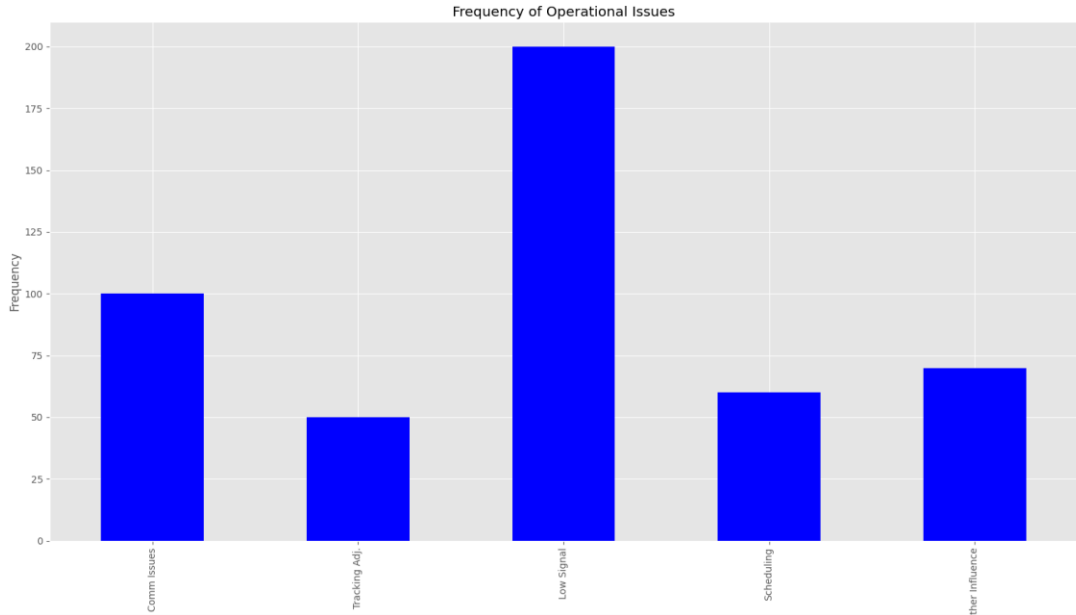
Save Analysis

Generate Visuals

Close

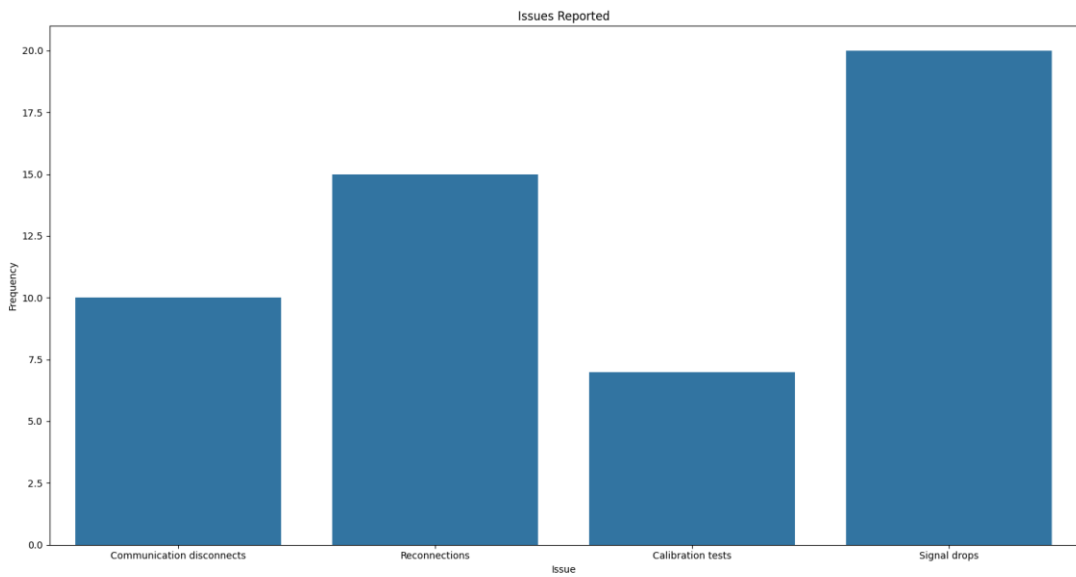
Figure 24: Analyzed Sequence of Events Data searched by antenna name

Figure 1



Navigation icons: Home, Back, Forward, Search, Print, Refresh. (x, y) = (5.8)

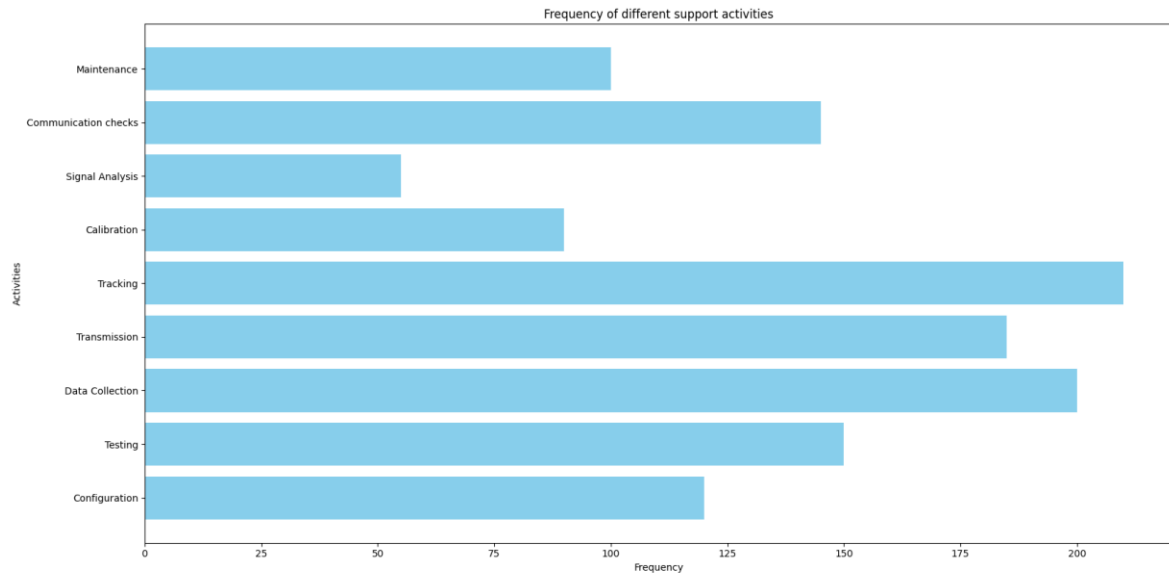
Figure 1



Navigation icons: Home, Back, Forward, Search, Print, Refresh.

Figure 1

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Figure 25: Visual Data generated from the results of the Analysis

Model Analysis Results

Trends and Patterns:

1. Throughout the report, it is observed that calibration processes for the RNG and LRO testing were frequently conducted and generally successful.
2. Several instances of signal issues, including low but stable signal or brief signal loss were reported.
3. Notably, there were instances where the HBK2 axis stopped moving and programming was restarted.

Performance:

1. Both the 12m and 26m antennas were utilized throughout the processes, proving instrumental in testing and calibration efforts.
2. There were multiple instances where the HBK2 axis stopped moving which could have hindered operations.
3. The communication between the team members seemed effective and prompt which helped in troubleshooting and decision-making.

Recommendations:

1. Investigate the frequent stopping of the HBK2 axis to prevent future interruptions to processes.
2. To counteract the issue of signal drop-outs and low signals, potential equipment upgrades or additional support mechanisms could be considered.
3. Routines and protocols could be reviewed and revised to ensure that the all the steps are properly conducted and all the instruments are well set-up to decrease the chances of anomalies occurring.

Conclusion:
The report details a series of tests and operations carried out using 12m and 26m antennas. Despite some minor issues, it appears that operations were conducted successfully indicating an effective team and

Knowledge Transfer:
The knowledge from this analysis can be transferred to the workforce through a real-world example. Key operational processes can be highlighted, as well as anomalies that arose. Additional focus could be placed on the important findings in the report, to support process efficiency.

Tools for Knowledge Transfer:

1. Training Seminars: These are an effective way to educate staff on new processes and report as a case study to discuss problem-solving, teamwork, and equipment

Success

Analysis saved and converted to PDF: D:/Data Mining/SpaceOps2025/Data Mining/Data Sets/Analysis logs/Analysis Logs 2/Test Data/Analysis_Log_2025-05-16 10-56-02.pdf

OK

Save Analysis

Generate Visuals

Close

Figure 26: Option to save the Analysis for future reference

← → ↑ This PC > DATA (D:) > Restore > kmbuyisa > bbbbbb > biblical > KENYA > Knowledge > SpaceOps2025 > Data Mining > Data Sets > Analysis logs > Analysis Logs 2

Name	Date modified	Type	Size
Analysis_Log_2025-04-04 12-08-24	04/04/2025 12:08	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-09-19	04/04/2025 12:09	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-14-14	04/04/2025 12:14	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-50-07	04/04/2025 12:50	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-50-56	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-51-30	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 13-26-10	04/04/2025 13:26	Microsoft Word Doc...	39 KB
Analysis_Log_2025-04-04 13-26-10	04/04/2025 13:26	Microsoft Edge PDF ...	103 KB
Analysis_Log_2025-04-04 13-29-35	04/04/2025 13:29	Microsoft Word Doc...	39 KB
Analysis_Log_2025-04-04 13-29-35	04/04/2025 13:29	Microsoft Edge PDF ...	103 KB

Figure 27: Option to choose a file path to save the analysis for future reference

Analysis of SEQUENCE of EVENTS

Analysis:

1. The report provides information on the testing procedures, observed results, and pertinent challenges during operational activities coverage on the IM-1 Satellite.
2. The 12m and 26m antennas were persistently used for operations, performing tests, calibrations, and communication activities.
3. The signal strength ebbed and flowed numerous times, resulting in frequency shifts and reconfigurations. This indicates some stability issues that should be addressed.
4. There were multiple instances (15/02/2024, 22/02/2024, 22/02/2024, 28/02/2024) where the testing station lost contact with the satellite which delayed the completion of the task.
5. The report indicates that there were issues with communication both within the testing team and with the IM-1 Satellite.

Trends and Patterns:

1. Problems with connectivity and antenna signal strength were persistent throughout the satellite's operational period.
2. Reconfigurations were a repetitive pattern indicating insufficient initial settings or constant situational changes that required adaptation.
3. The Antenna Used frequently switched between 12m and 26m. The relationship and coordination between the two antennas seem substantive for the overall operation.

Performance:

1. The performance appears to be subpar with several incidents of signal loss, forced reconfigurations, and communication trouble.
2. Frequent delay, lack of communication, and technical glitches were noted.

Recommendations:

1. Foster clearer channels of communication: The frequent periods of lost contact suggest a need for better communication channels. If the purpose is clarified and there is a smoother coordination process, it would allow for more successful operations.
2. Enhance the training of staff: Given the issues with equipment configuration and the troubleshooting methods employed, the staff could likely benefit from deeper training on the technical aspects of handling the equipment.
3. Regular Maintenance: Scheduled and routine maintenance of the equipment might mitigate some of the issues seen with the antennas.

Conclusions:

Figure 28: Analysis saved in MS Word and PDF format

Figure 29: Extracted Anomalies Occurred Data searched by antenna name

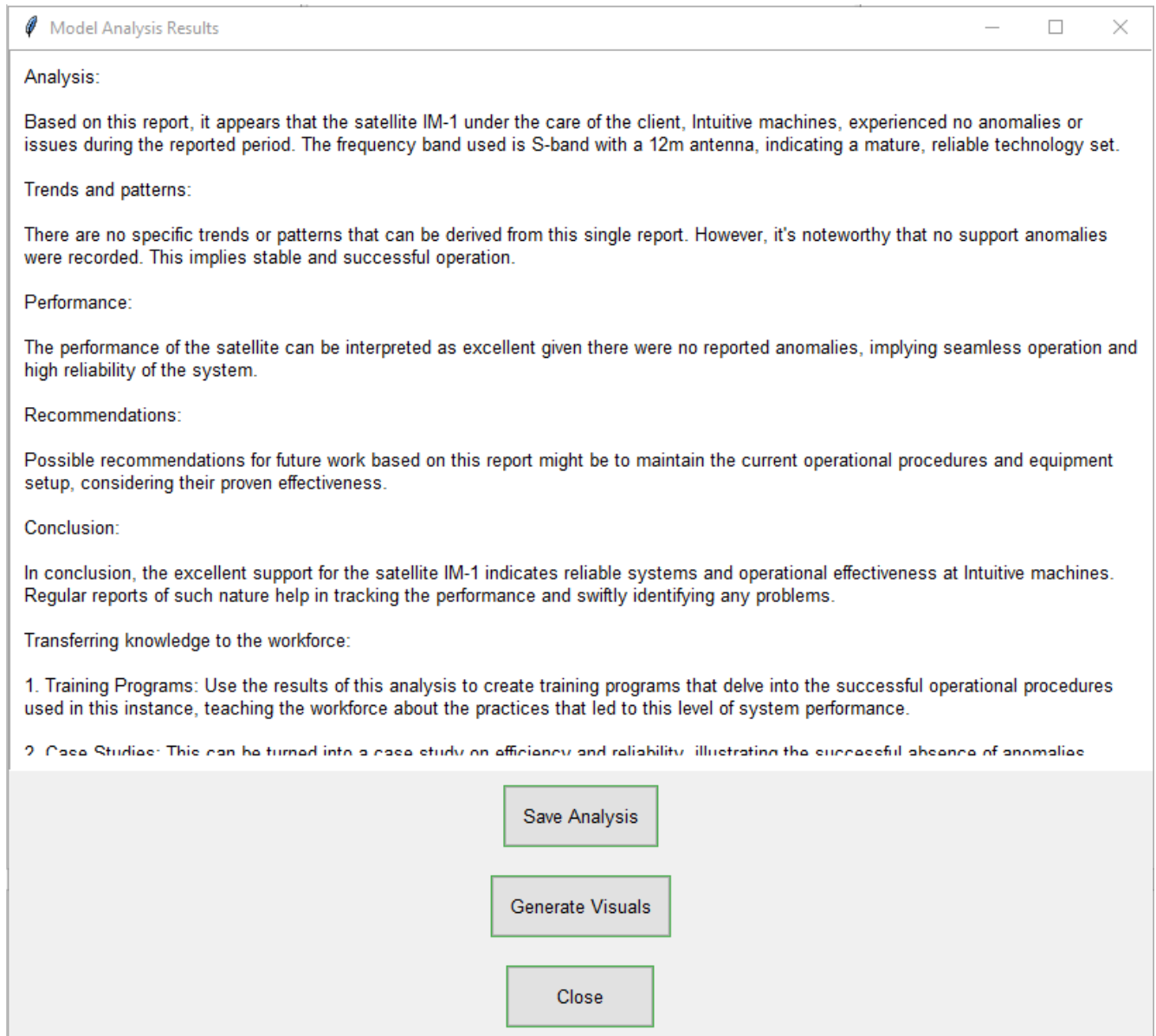


Figure 30: Analyzed data searched by antenna name

Figure 1

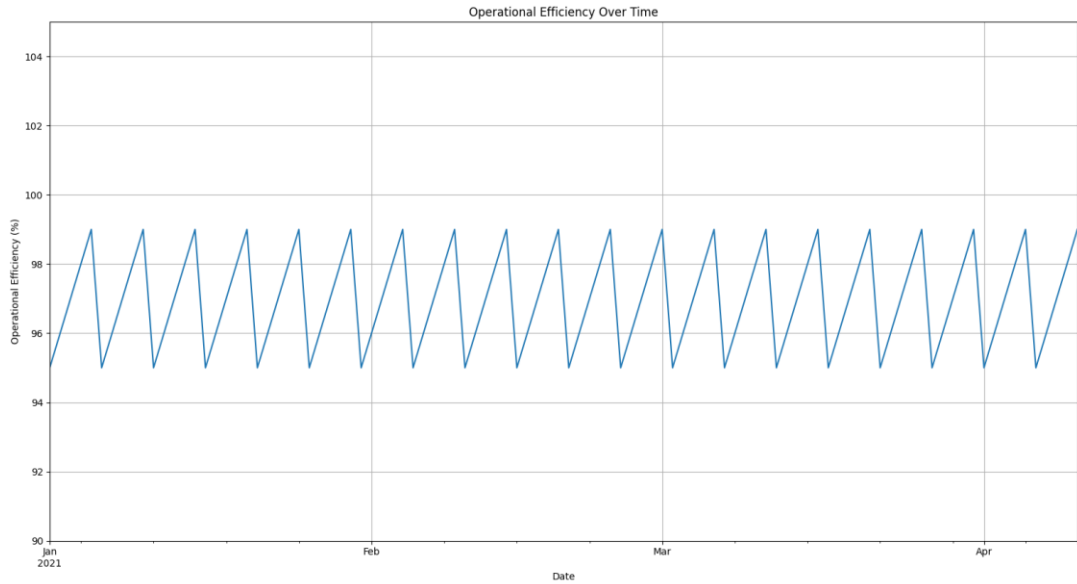


Figure 1

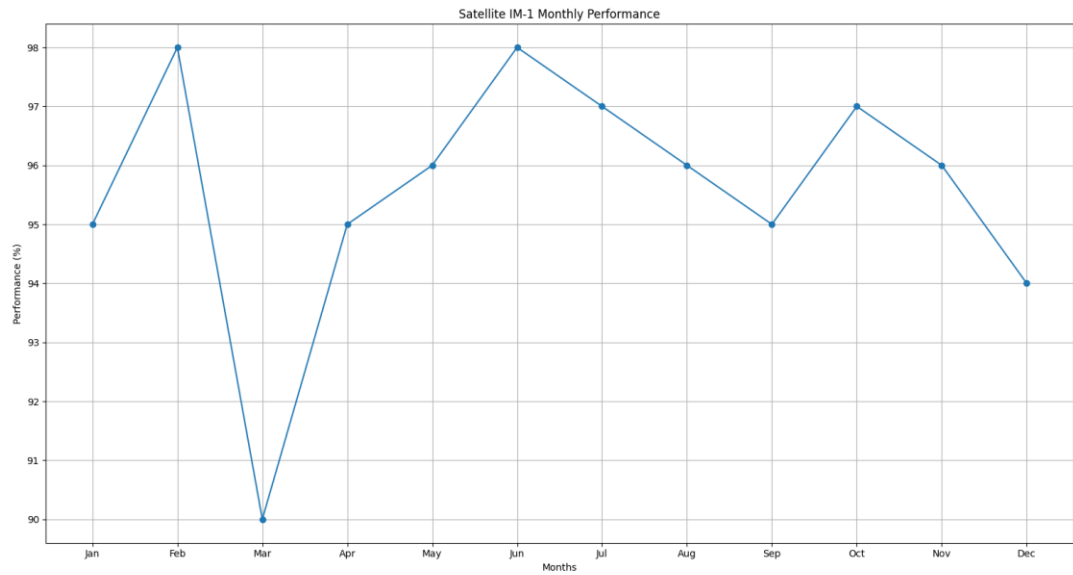
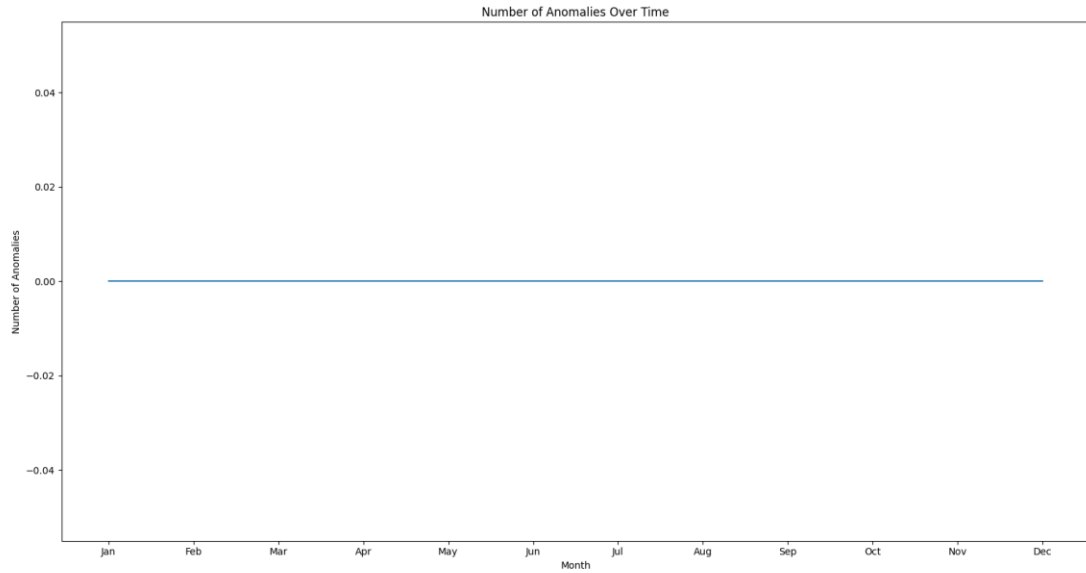


Figure 1

Figure 1

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Figure 31: Visual Data generated from the results of the Analysis

Model Analysis Results

Based on the provided information, there isn't enough substantial data to analyze. However, from the given brief data, a few points can be keyed out:

1. The report compiled belongs to 'Intuitive Machines' located presumably in an aerospace/ satellite technology space, indicated by the use of the 'Satellite Name: IM-1'.
2. A 12m antenna was used with an S-band frequency. S-band frequency usage means that the operations likely involve the weather radar, surface ship radar, and some communications satellites which typically avoid heavy rainfall interference in the signal paths.
3. No support anomalies were recorded which indicated successful and smooth operations during the period the report was compiled.

Recommendations:
 It's impressive to maintain a record without any anomalies. However, continuous improvements and regular system checks should be done to maintain this level of operation. Staff training and frequent updates on tech advancements should be implemented.

Conclusions:
 The operations for IM-1 are running smoothly with no recorded support anomalies. This implies that the desired objectives are currently being met with the existing systems and procedures.

Transferring knowledge to the workforce:
 The workforce should be trained about using specific antenna types and frequency bands for specific operation types. Also, they should be taught how to maintain this zero anomaly record which they can achieve by carrying out regular system checks and preventive maintenance.

Please note, for more accurate analysis, trends, patterns, detailed records, and comprehensive data.
 A detailed roadmap and structured knowledge transfer might involve a multi-step process, identifying the target audience for the knowledge transfer, designing the knowledge transfer method, and evaluating the effectiveness of the knowledge transfer.

1. Identifying the Target Audience:
 Before transferring knowledge, it's critical to identify who will receive the knowledge. This could include existing employees acquiring new roles or work projects, or even teams.

Success

Analysis saved and converted to PDF: D:/Data Mining/SpaceOps2025/Data Mining/Data Sets/Analysis logs/Analysis Logs 2/Test Data/Analysis_Log_2025-05-16 12-25-22.pdf

OK

Save Analysis

Generate Visuals

Close

Figure 32: Option to save the Analysis for future reference

This PC > DATA (D:) > Restore > kmbuyisa > bbbbbb > biblical > KENYA > Knowledge > SpaceOps2025 > Data Mining > Data Sets > Analysis logs > Analysis Logs 2

Name	Date modified	Type	Size
Analysis_Log_2025-04-04 12-08-24	04/04/2025 12:08	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-09-19	04/04/2025 12:09	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-14-14	04/04/2025 12:14	Microsoft Edge PDF ...	100 KB
Analysis_Log_2025-04-04 12-50-07	04/04/2025 12:50	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-50-56	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 12-51-30	04/04/2025 12:51	Microsoft Edge PDF ...	98 KB
Analysis_Log_2025-04-04 13-26-10	04/04/2025 13:26	Microsoft Edge PDF ...	103 KB
Analysis_Log_2025-04-04 13-29-35	04/04/2025 13:29	Microsoft Edge PDF ...	103 KB
Analysis_Log_2025-04-04 13-46-57	04/04/2025 13:46	Microsoft Word Doc...	39 KB
Analysis_Log_2025-04-04 13-46-57	04/04/2025 13:47	Microsoft Edge PDF ...	101 KB

Figure 33: Option to choose a file path to save the analysis for future reference

Analysis of Anomalies Occurred

Since the provided information is insufficient to create a detailed analysis, we can only work on the data provided as per the post-support report of client Intuitive Machines for their IM-1 satellite.

Trends and Patterns:

Our observable data does not provide much in terms of trends and patterns due to the lack of comparative or sequential data. However, it can be inferred that the satellite IM-1 is functioning correctly as there are no recorded support anomalies.

Performance:

The performance of the IM-1 satellite appears to be efficient and without issues, as there have been no recorded support anomalies. This suggests that the satellite is operating smoothly. The use of a 12m antenna and the S-band frequency also indicates a potentially strong, clear signal.

Recommendations:

While the current report shows no anomalies, it's critical to continue diligent monitoring since even minor issues could quickly escalate in a space setting. Regular system checks and maintenance can aid in the early detection of potential abnormalities.

Conclusions:

In conclusion, the system is currently functioning as expected without any anomalies. It's crucial to maintain the continuity of operations, scheduled system checks, and routine maintenance.

Knowledge Transfer:

To transfer/equip the workforce with the knowledge from this analysis, conduct training sessions or workshops detailing how these regular checks minimize the potential for anomalies. Guide teams on how to analyze and compile such reports effectively. The main takeaway is the importance of regular monitoring and reporting, even when no anomalies appear, in order to maintain efficient operations and preemptively resolve any unforeseen issues.

Knowledge Transfer Roadmap:

1. Identify Knowledge to Transfer

Identify specific skills, processes, tools, or techniques that must be transferred to the team. For example, they need to know how to monitor the performance of a satellite, how to use a 12m antenna, and what an S-band frequency signifies.

Figure 34: Analysis saved in MS Word and PDF format

5. Discussion and Recommendations

Currently, the GPT-4 OpenAI model is linked to python data mining software to receive accurate real-time analysis of the data extracted from post-launch mission reports in the organization’s database. This model is a bit costly because it uses API key to link the python code to the model. To activate the API key, tokens must be purchased depending on which version of the model has been selected. There are open-source models that are remote but must be downloaded locally such as stablelm-zephyr-3b which requires 5.59GB of space in the local computer before the model can run the analysis. To run the analysis, the model must first be stored in the local computer of which the PC must have enough space and memory to accommodate the model. Then the input data must be fed into the model, and the model analyses the data and displays it on the GUI. Due to the size of the model, the CPU fails to process the data and takes too long to analyse and produce results. Meta AI as well, requires about 2.47GB of space so the computational resources such as CPU is too small. For these models, GPU is required or even a server that has a GPU can be used which can be quite expensive and enough time is required to train the models. Disadvantages of using pre coded models is that at times the analysis results provide the same answer for every data which can be inaccurate sometimes. Owing to reasons above, connecting to OpenAI seemed feasible as writing the whole code including the model and fine tuning/training the model will take time and computational resources mentioned above are more costly. For a model to handle half a billion parameters, GPU requirements would be 32GB of space and 64GB of Random Access Memory (RAM) and for a billion parameters the requirements would be double to train the model.

Depending on the type of machine being used, simulations showed that when running the code, it takes between 5.96 – 6.04 seconds to open the GUI, between 02:8.59 seconds – 24 seconds to search and read the reports in the folder and display them on the GUI, and between 12.17 -17.94 seconds to run the analysis and display it on the pop-up window depending on the size of the data and how often the analysis is being run. The more the software runs the analysis the model is somewhat being trained to respond faster and give more accurate results. It is also noted that depending on the version of the OpenAI model used at a time and that the data analysis occurs in real-time, the result of the analysis differs in wording every time the chatbot analyses the same data input, though the interpretation or meaning remains the same. Since OpenAI is not free, there are various price plans to choose from, and this affects the model the OpenAI will choose to run the analysis. If the code is written in such a way that the OpenAI must choose the best model to analyse the data, this will affect the credit balance/price plan because the OpenAI will choose the best model that is within the credit balance/price plan to give the most accurate results. According to this python data mining software, the code is written in such a way that the model is specified and in this case is GPT-4 which means that the OpenAI will choose the best/latest version of the model GPT-4 covered by the credit balance/price plan to give the most accurate results.

The current Open AI model analyses the data and provides trends and patterns of the extracted data, performance, recommendations, conclusion and the knowledge to be transferred to the workforce as well as tools/guidelines/roadmap. Managers can use these guidelines and tools to ensure that this newfound knowledge is fully transferred to the workforce.

The recommended pretrained models to analyse and generate text and visual data is shown below:

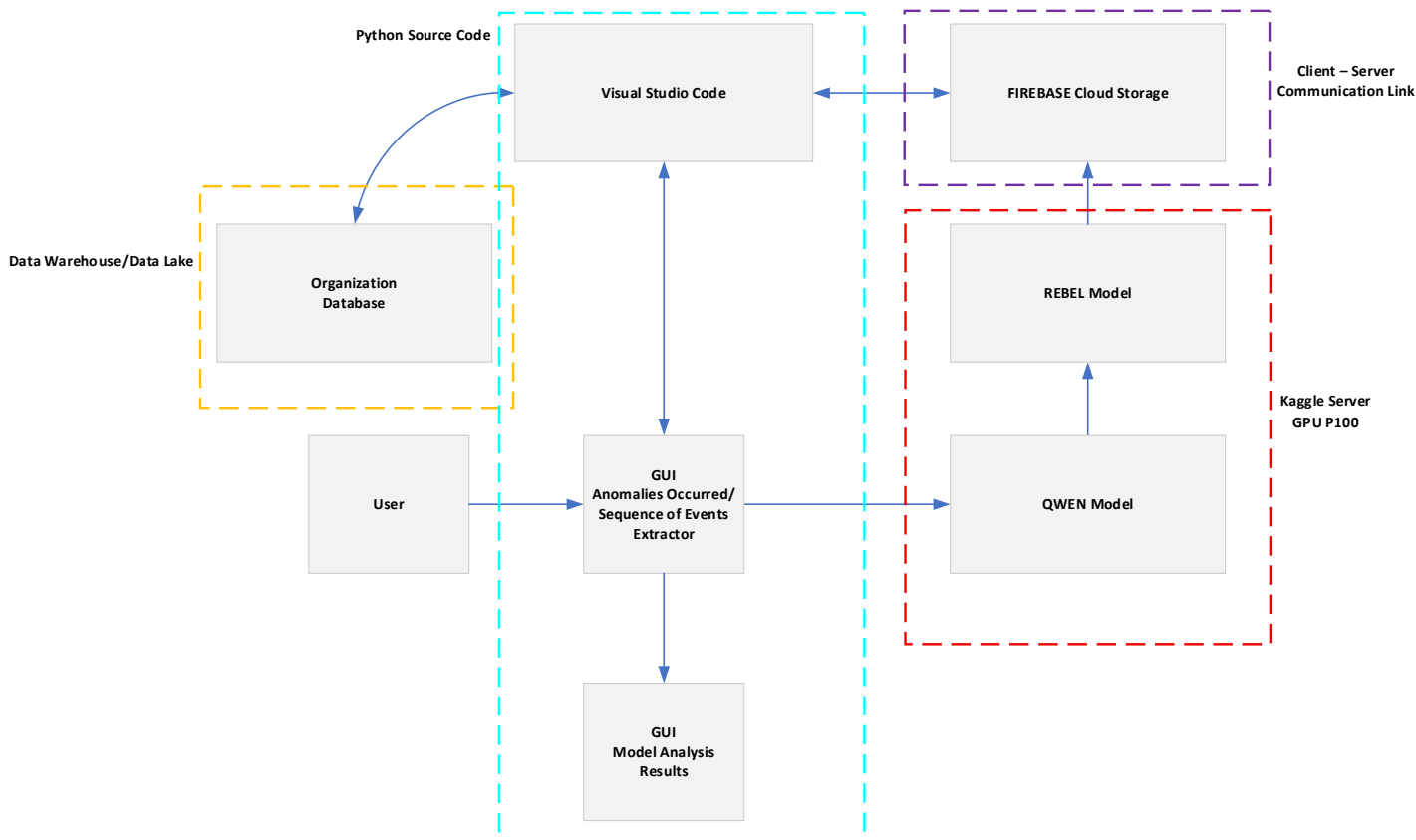


Figure 35: Process of Data Mining and Analysis using Pre-trained QWEN & REBEL Models

The two models QWEN and REBEL function as text and visual data analysis models. The python script (data mining software) searches, reads and extracts required data from post-mission reports stored in the organization’s database and displays it on the GUI. The user then runs analysis from the GUI by clicking the analysis tab on the GUI which will then send the command to the data mining software. The data mining software will then prompt the QWEN model to analyze the extracted data and give trends and patterns, performance, recommendations and conclusion and the knowledge to be transferred to the workforce as well as the tools on how to transfer this newfound knowledge. The model then sends the results of the analysis as a text data that is then fed into the REBEL model to generate visual data such as graphs, charts, images etc. The visual data is then sent to the Visual Studio Code (data mining software) via a client server communication link REBEL cloud storage. The data mining software then fetches the visual data from FIREBASE cloud storage and displays it on a separate pop-up window as results of the analysis. Both models are built in the Kaggle server, but they are a product of Alibaba (QWEN) and Hugging face (REBEL). Kaggle acts as a server and has a built in GPU from NVIDIA. The models were trained using GPU T4 x 2 and tested using GPU P100. FIREBASE is a cloud storage that provides client-server communication link between the REBEL model and Visual Studio Code since Kaggle restricts TCP connections. The output from the REBEL model is sent to client Visual Studio Code (VS Code) by converting it to Json format and sending it via FIREBASE in a Json format and the client (VS Code) decodes the output data and have it displayed on a separate pop-up window as the results of the analysis containing both text and visual data.

Currently, the challenge is that when the output data from REBEL model is converted to Json format, data gets corrupted before it can even be stored to FIREBASE. FIREBASE only accepts the Json format as standard. Due to the lack of computational resources, the two models will have to be run separately on Kaggle to generate the data that will then be sent to VS Code via FIREBASE client server communication link. There are a few models that can be explored such as DALL·E (by OpenAI), Stable Diffusion (by Stability AI), Midjourney (proprietary service), Imagen (by Google, not publicly released as of now).

6. Conclusions

The current method of deploying AI analysis via OpenAI's GPT-4 model can be changed to an on-premises deployment using the LLama model hosted on the organizational server that has GPU capabilities to address growing concerns regarding data privacy and security as well as client confidentiality.

The current setup involves reading reports from documents through a GUI and sending them to OpenAI's GPT-4 model for analysis using OpenAI keys. While this method has been effective in leveraging advanced AI capabilities, it raises significant privacy concerns due to the following reasons:

- **Data Transmission:** Sending sensitive data over the internet to an external service increases the risk of data breaches and unauthorized access.
- **Third-Party Dependency:** Relying on an external service for data processing means we have limited control over data handling and storage practices, which may not fully align with our privacy policies.
- **Compliance Issues:** Adhering to stringent data privacy regulations such as General Data Privacy Regulation (GDPR), California Consumer Privacy Act (CCPA), or the South African Protection of Personal Information Act (POPIA) becomes challenging when data is processed by third-party services.

To mitigate these privacy concerns, transitioning to an on-premises deployment using the LLama model hosted on the organizational server with GPU capabilities will:

- Enhance data privacy by processing data locally on the servers to eliminate the need to transmit sensitive information over the internet, significantly reducing the risk of data breaches.
- Provide full control over data handling, storage, and access to ensure compliance with the organization's internal privacy policies and regulatory requirements.
- Allow the organization to implement robust security measures tailored to the organization's specific needs, further safeguarding sensitive information.
- Efficiently handle multiple client requests simultaneously, ensuring timely and accurate analysis without compromising on performance.

To ensure optimal performance, deploying the LLama model on the server requires specific hardware and system configurations such as:

- **GPU Requirements:** For efficient deployment of the LLama model, we recommend using NVIDIA A100 GPUs with at least 80GB of VRAM. This setup will support high-precision fine-tuning and training tasks².
- **CPU and RAM:** Multi-core processors (8-16 cores) with high clock speeds (3.0 GHz or above) and at least 32GB of system memory are recommended to handle model workloads and ensure smooth multitasking³.
- **Storage:** Adequate storage capacity is essential to manage the large datasets and model parameters. We recommend using SSDs for faster data access and retrieval.

Cost Implications: While the initial setup cost for deploying the LLama model on our server may be higher compared to using cloud-based services, the long-term benefits outweigh the costs:

- **Hardware Costs:** The upfront cost for purchasing NVIDIA A100 GPUs and other necessary hardware components can range from R50,000 to R360 000.
- **Operational Costs:** Running the model locally will incur electricity and maintenance costs. However, these costs are offset by the elimination of recurring cloud service fees and the enhanced control over data privacy and security².

Advantages of Running on SANSA's Private Network with Firewalls: Deploying the LLama model on the network with firewalls provides additional security benefits:

- **Network Security:** Our private network is equipped with advanced firewalls that protect against unauthorized access and cyber threats, ensuring that sensitive data remains secure.
- **Controlled Access:** By restricting access to the network, we can ensure that only authorized personnel can interact with the model, further enhancing data privacy.
- **Compliance:** Running the model on our private network helps us maintain compliance with industry-specific regulations and standards, providing peace of mind to our clients and stakeholders.

Transitioning to an on-premises deployment using the LLama model will not only address the organization’s privacy concerns but also enhance our overall data security and compliance posture. This change is crucial for maintaining the trust of the clients and stakeholders while continuing to leverage the benefits of AI-driven analysis.

The model can be finetuned further to give actual knowledge to be transferred instead of providing guidelines or tools, so that the workforce can learn straight from the system while analysing data rather than having to wait for training materials to be compiled.

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