

# Requirements Engineering with Assistant GPT

By Amir Abrari

Requirements Engineering GPT



Approved for Public Release

# Presenter

## Amir Abrari

- SPEC Systems Engineer
- Integrated ChatGPT API and AI onto the Innoslate Cloud platform
- Specializes in MBSE, LML, and LLM
- Experienced in OpenAI ChatGPT, Perplexity, and Claude.Ai



# Introduction

# Purpose

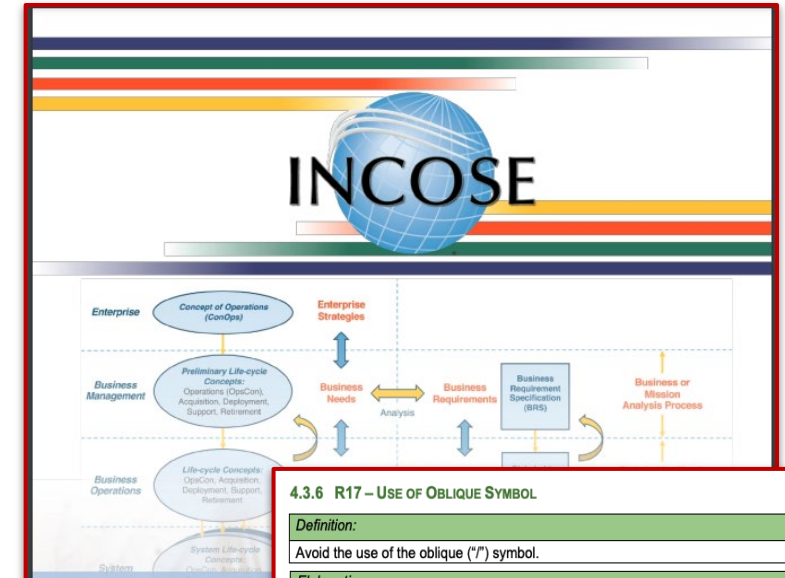
- Part of an exploratorion task to evaluate how ChatGPT responds as a **Requirements Engineering assistant**
- Evaluate the true value of the **OpenAI GPT creator** for a “**no code**” solution
- Provide a **temporary solution** to our Systems Engineers **while we develop assistants on the Innoslate software**
- Make the custom trained GPTs **available to the Public**

# Process

1. Understand the Requirements WG V4 Writing Guide
2. Setup custom GPT (Generative Pre-trained Transformer) using OpenAI's interactive interface
3. Adjust GPT attributes such as name, description, instructions, capabilities, and knowledge files
4. Conduct Functional and Knowledge Testing to ensure the GPT is responding appropriately to requirements engineering prompts

# Requirements WG V4 Writing Guide

- Established in 1992
- Requirements Working Group (RWG)
- Latest Version of the Requirements Writing Guide V4 in July 2023
- Not a Standard but Companies are implementing as a standards



**4.8.2 R30 – UNIQUE EXPRESSION**

**Definition:**  
Express each need and requirement once and only once.

**Elaboration:**  
Avoid including the same or equivalent need and requirement more than once, either as a duplicate or in similar form. Exact duplicates are relatively straightforward to identify; finding similar need or requirement statements with slightly different wording is much more difficult but is aided by the consistent use of defined terms (R4) and by classification (R29), as well as the use of a properly defined project data dictionary, ontology or glossary in which synonymies and equivalences between terms and acronyms can be defined.  
NLP/AI tools can help in the identification of duplicates or similar needs or requirements. In any case, when following the agreed patterns for statement (R1) and a data dictionary, the detection of duplicates and similar results far easier.  
Avoidance of duplication can be aided by classification (R29) so a subset of needs or requirements can be compared.

**Examples:**  
Exact duplicates can be found by matching of text strings. The main problem is to identify similarities with different expressions, but which are equivalent.  
For example, the following statements are overlapping in that the first is a subset of the second:  
The <SOI > shall generate a report of financial transactions containing the information defined in <some standard or contract deliverable listing>.  
The <SOI> shall generate a financial report containing the information defined in <some standard or contract deliverable listing>.

**4.3.6 R17 – USE OF OBLIQUE SYMBOL**

**Definition:**  
Avoid the use of the oblique ("/") symbol.

**Elaboration:**  
... possible meanings that it should be avoided.  
... budget/schedule" or the construct "and/or" ...  
... elements that do not reflect accurately the true ...  
... which the needs in the Integrated Set of Needs

... e symbol is used in units (for example "km/h") or ...  
... value (for example +/- 5 degrees F).  
... pressing ratios or fractions (such as 1/16)—see

... n shall Open/Close the User\_Account in less than ...  
... s to what is meant by open/close: open, close, or ...  
... appropriate condition)  
... system shall Open the User\_Account in less than 1 ...  
... system shall Close the User\_Account in less than 1 ...  
... and/or the Brake is Applied, the ...  
... the Speed\_Control\_Subsystem within <YYZ ms>

# Requirements GPT

# Setup Custom GPT

The screenshot displays the 'Requirements Engineering with Assistant GPT' builder interface. On the left, the 'Create' tab is active, showing a chat conversation where the user defines the GPT's purpose (following INCOSE WG V4) and name ('Requirements Engineering with Assistant GPT'). The right side shows the 'Preview' tab, which displays the final GPT card with its name, description, and four sample prompts: 'Create a requirement that follows the INCO...', 'How can I improve this requirement to match INCOSE W...', 'Review this requirement for compliance with...', and 'Help me structure a requirement following INCOSE...'. A blue double-headed arrow connects the two panels.



# Side to Side GPT Mapping

The image shows a side-by-side comparison of a GPT configuration interface (left) and its preview (right). The interface is divided into two main sections: 'Configure' and 'Preview'.

**Configure View (Left):**

- Name:** Requirements Engineering GPT by SPEC Innovations
- Description:** Generates Requirements for Systems Engineers powered by the INCOSE Requirements Writing Guide, including rationales for each requirement.
- Instructions:** formal, professional manner suitable for corporate requirements writing settings. For questions that concern Innoslate's software, browse and refer the <https://help.specinnovations.com/> and learn about what is being asked about before writing requirements on the subject you are being prompted. For example, if the prompt is about Project Management on Innoslate, browse the help center on content regarding PM on Innoslate first, learn, and then generate requirements on it. Using bias without asking for more context cannot happen. Once the first round of requirements is generated, always ask users if they would like to get into more specifics and lower level requirements for specific sections.
- Conversation starters:** A list of five prompts, each with a close button (X):
  - Generate system feature requirements for a new autonomous vehicle project.
  - List the interface requirements for integrating a new software module.
  - Create a comprehensive set of security requirements for a cloud-based application.
  - Provide requirements and rationales for a new user authentication system.
  - (Empty prompt)
- Knowledge:** If you upload files under Knowledge, conversations with your GPT may include file contents. Files can be downloaded when Code Interpreter is enabled.
- Knowledge Files:** Automating-The-INCOS... PDF, INCOSE\_RWG\_GtWR\_V... PDF

**Preview View (Right):**

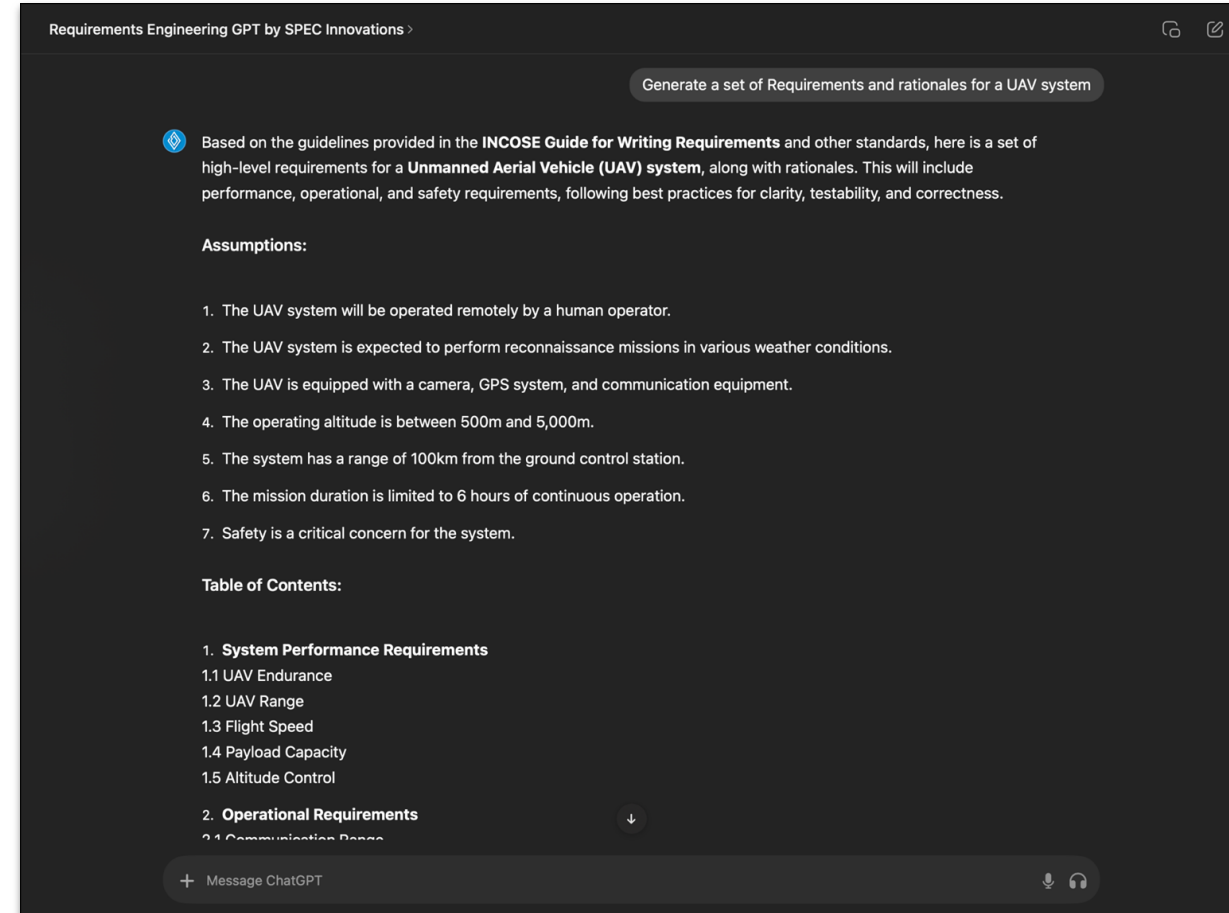
- Name:** Requirements Engineering GPT by SPEC Innovations
- Description:** Generates Requirements for Systems Engineers powered by the INCOSE Requirements Writing Guide, including rationales for each requirement.
- Conversation starters:** A list of four prompts:
  - Generate system feature requirements for ...
  - List the interface requirements for integrating a new...
  - Create a comprehensive set of security...
  - Provide requirements and rationales for a...

**Mapping (Arrows):**

- 1 (Red):** Points from the GPT icon in the 'Configure' view to the GPT icon in the 'Preview' view.
- 2 (Blue):** Points from the 'Name' field in 'Configure' to the 'Name' field in 'Preview'.
- 3 (Green):** Points from the 'Description' field in 'Configure' to the 'Description' field in 'Preview'.
- 4 (Yellow):** Points from the 'Conversation starters' list in 'Configure' to the 'Conversation starters' list in 'Preview'.

# Use Case

- Once the GPT is setup, iterative testing was conducted.
- Output follows specific a uniform structure:
  - Assumptions
  - Table of Contents
  - Requirement Categorization
  - Requirements & Rationale



# Assumptions

- “AI placebo effect”
- “**The Assumptions You Bring into Conversation with an AI Bot Influence [its output].**”
- This feature allows a **checkpoint and communication stream** between Human and AI
- **Adjust and Refine** based on Context

## Assumptions:

1. The UAV system will be operated remotely by a human operator.
2. The UAV system is expected to perform reconnaissance missions in various weather conditions.
3. The UAV is equipped with a camera, GPS system, and communication equipment.
4. The operating altitude is between 500m and 5,000m.
5. The system has a range of 100km from the ground control station.
6. The mission duration is limited to 6 hours of continuous operation.
7. Safety is a critical concern for the system.

# Table of Contents

- **Instructed to outline** its output and requirements hierarchy.
- Allows user to **verify structure** and **adjust** to different hierarchies or containment trees.

## Table of Contents:

### 1. **System Performance Requirements**

1.1 UAV Endurance

1.2 UAV Range

1.3 Flight Speed

1.4 Payload Capacity

1.5 Altitude Control

### 2. **Operational Requirements**

2.1 Communication Range

2.2 Environmental Operating Conditions

2.3 Camera Resolution

2.4 Flight Control

### 3. **Safety Requirements**

3.1 Collision Avoidance

3.2 Emergency Landing

3.3 Battery Management

# Requirement Categorization & Output

- Once Assumptions and Table of Contents are generated:
  - GPT generates proper **Requirements for each hierarchy level**
  - GPT generates **Rationale complimenting the Requirement description**

1. System Performance Requirements

**1.1 UAV Endurance**

**Requirement:** The UAV system shall be capable of continuous flight for at least 6 hours without refueling or recharging.  
**Rationale:** Ensures that the UAV can complete long-duration reconnaissance missions without interruptions.

**1.2 UAV Range**

**Requirement:** The UAV system shall have an operational range of no less than 100 km from the ground control station.  
**Rationale:** This enables the UAV to cover extensive areas for surveillance and reconnaissance without requiring proximity to the control station.

**1.3 Flight Speed**

**Requirement:** The UAV system shall be capable of flying at speeds ranging from 50 km/h to 150 km/h.  
**Rationale:** Allows for flexible mission planning, whether for fast reconnaissance or slower, more detailed inspections.

**1.4 Payload Capacity**

**Requirement:** The UAV system shall be capable of carrying a payload of up to 20 kg, including cameras and sensors.  
**Rationale:** Ensures sufficient capacity for carrying various mission equipment, enhancing the UAV's operational versatility.

**1.5 Altitude Control**

**Requirement:** The UAV system shall be capable of operating at altitudes between 500 meters and 5,000 meters above ground level.  
**Rationale:** Provides operational flexibility to fly at different altitudes, improving mission success based on environmental and tactical needs.

2. Operational Requirements

**2.1 Communication Range**

**Requirement:** The UAV system shall maintain reliable communication with the ground control station at distances of up to 100 km, even in poor line of sight conditions.

# Expand to Lower Level Requirements

- Once initial Requirements are generated, the GPT can be prompted to **expand** on **all or specific** categories.
- Can expand multiple levels of abstraction down

Expand to lower level requirements for 2. Operational Requirements category

Here is an expanded set of lower-level requirements for the **Operational Requirements** category of the UAV system. This will break down each high-level requirement into more detailed and specific statements, ensuring they remain measurable, verifiable, and clear.

**2. Operational Requirements**

**2.1 Communication Range**

**2.1.1 Line-of-Sight Communication**

**Requirement:** The UAV system shall maintain uninterrupted communication with the ground control station for distances up to 100 km in line-of-sight conditions.  
**Rationale:** Ensures operational efficiency in open areas, where obstacles do not interfere with signal transmission.

**2.1.2 Non-Line-of-Sight Communication**

**Requirement:** The UAV system shall maintain communication with the ground control station at distances up to 50 km in non-line-of-sight conditions using a combination of satellite and radio communication links.  
**Rationale:** Provides operational flexibility in complex terrains, such as urban areas or forests, where line-of-sight may be blocked.

**2.1.3 Signal Loss Handling**

**Requirement:** The UAV system shall automatically switch to a pre-programmed return-to-base mode if communication with the ground control station is lost for more than 30 seconds.  
**Rationale:** Ensures safe recovery of the UAV in case of communication failure, reducing the risk of mission failure or loss of the UAV.

**2.1.4 Encryption of Communication Channels**

**Requirement:** The UAV system shall use AES-256 encryption for all communications between the UAV and the ground

# Rule Checking

- Given the GPT is trained on the INCOSE Ruleset, it can be prompted to reference and check which rules are followed.
- **GPT Pass/Flag** Requirements compliance one-by-one.

## 2.1 Communication Range

### 2.1.1 Line-of-Sight Communication

- **Requirement:** The UAV system shall maintain uninterrupted communication with the ground control station for distances up to 100 km in line-of-sight conditions.
- **Verification:**
  - **Rule R6: Use appropriate units:** The units (kilometers) are appropriately used.
  - **Rule R19: Use a single sentence:** The requirement is concise and uses a single sentence.
  - **Rule R36: Provide specific measurable performance targets:** The communication range is clearly specified (100 km).
- **Compliance:**  Passes R6, R19, R36.

### 2.1.2 Non-Line-of-Sight Communication

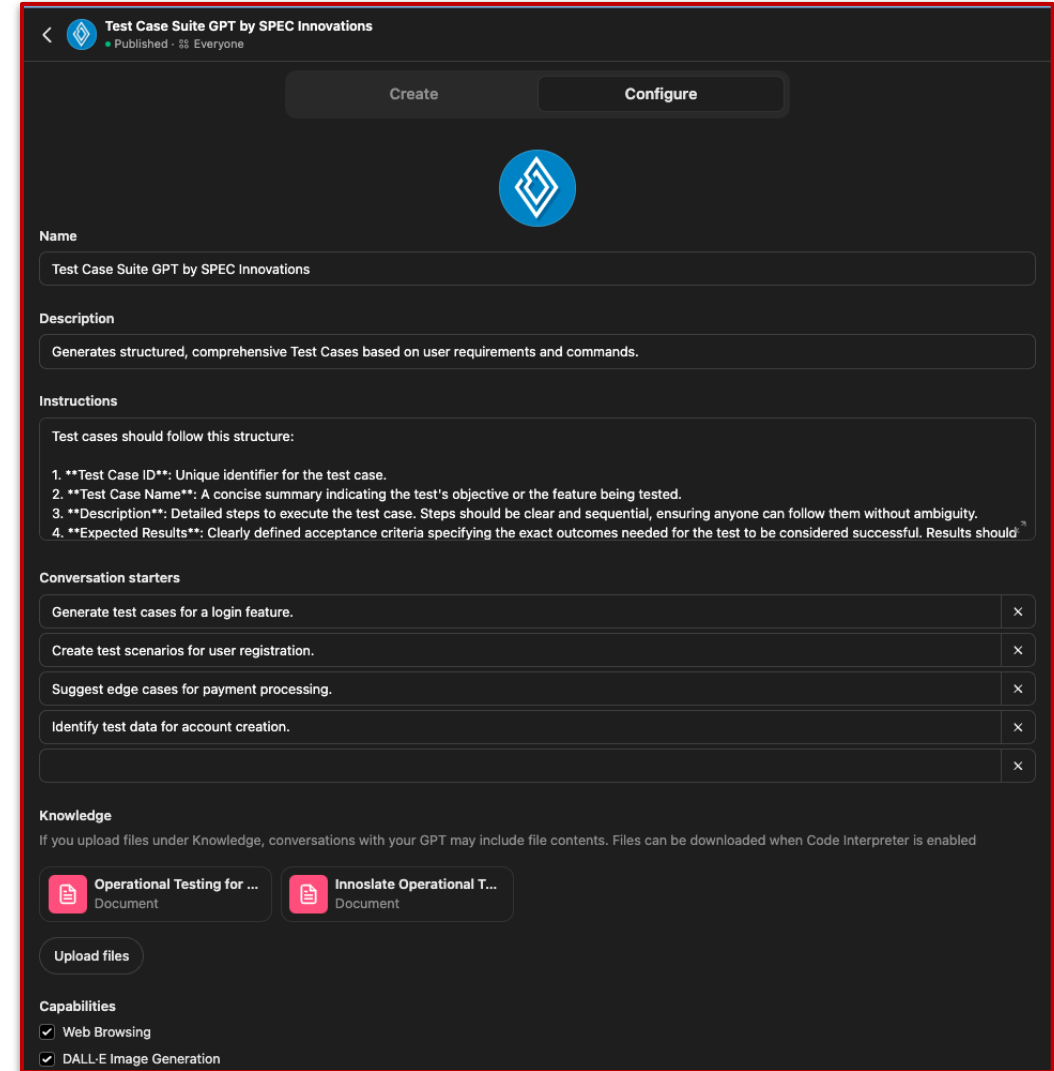
- **Requirement:** The UAV system shall maintain communication with the ground control station at distances up to 50 km in non-line-of-sight conditions using a combination of satellite and radio communication links.
- **Verification:**
  - **Rule R6: Use appropriate units:** The units (kilometers) are correctly specified.
  - **Rule R7: Avoid vague terms:** The phrase "a combination of satellite and radio" is somewhat vague, as it does not specify the exact technologies or how the combination works.
  - **Rule R36: Provide specific measurable performance targets:** The 50 km range is measurable.
- **Compliance:**  R7 violated due to vague reference to "a combination of satellite and radio". It passes R6 and R36.

# Test Case Suite GPT



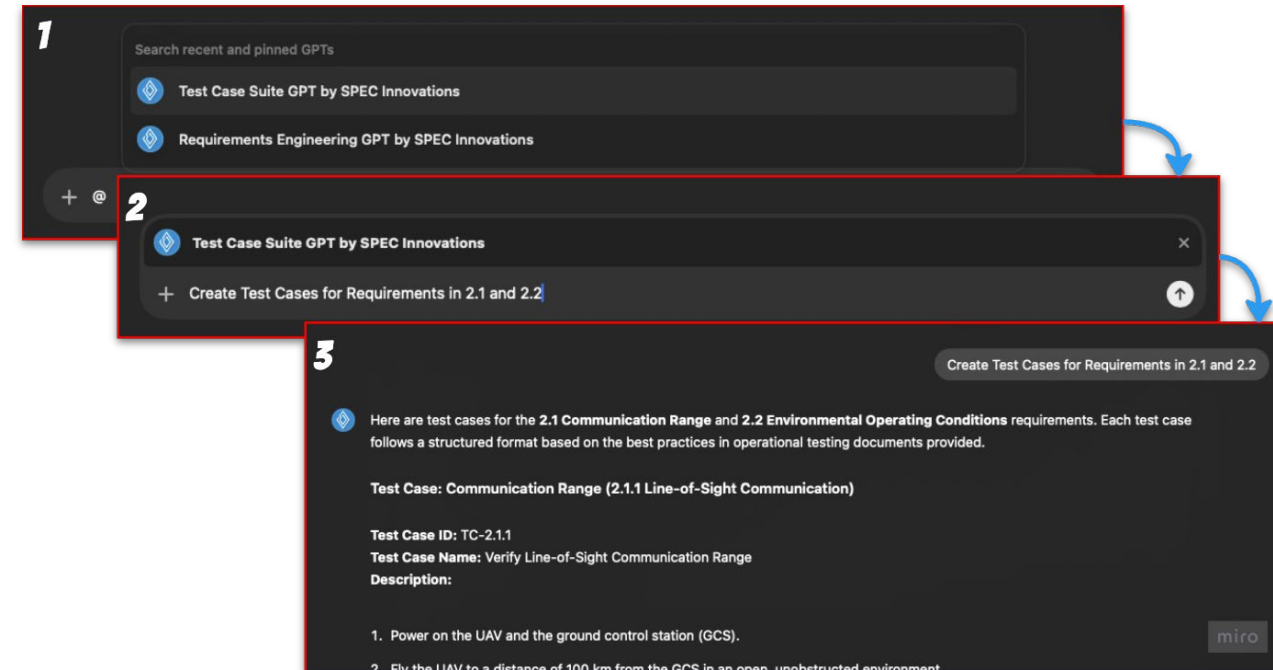
# Test Suite GPT

- Test Case Suite is a trained GPT
- Compliments Requirements GPT
- Provides uniform Test Case attributes of **Test Case ID, Name, Description, Expected Results, Verification Method, and Verified Requirement**



# GPT Referencing

- The “@” feature enables interaction between custom GPTs.
- Users can easily **switch between** and “call” GPTs for different tasks, such as creating test cases or managing requirements.
- Mimics “**agent**”like interaction between multiple GPTs



# Requirements & Test Case Results

- Test Case was generated directly from the **2.1.1 Line-of-Sight Communication** Requirement.
- Model used context from the Requirement to cater its Test Case Attributes.
- Test Steps and Expected Results specify thresholds.

**Test Case: Communication Range (2.1.1 Line-of-Sight Communication)**

**Test Case ID:** TC-2.1.1

**Test Case Name:** Verify Line-of-Sight Communication Range

**Description:**

1. Power on the UAV and the ground control station (GCS).
2. Fly the UAV to a distance of 100 km from the GCS in an open, unobstructed environment.
3. Monitor the communication link between the UAV and the GCS.
4. Verify that the communication remains stable with no interruptions throughout the flight.

**Expected Results:**

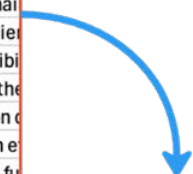
- Communication between UAV and GCS remains uninterrupted for the entire 100 km distance.
- No packet loss or delays in data transmission are observed.

**Verification Method:** Test

**Verifies Requirement:** 2.1.1 Line-of-Sight Communication

# CSV Import to Innoslate

Number	Name	Description	Rationale
1.1	UAV Endurance	The UAV system shall be capable of continuous flight for at least 6 hours without refueling or recharging.	Ensures the UAV can complete long-duration reconnaissance missions without interruptions.
1.2	UAV Range	The UAV system shall have an operational range of no less than 100 km from the ground control station.	Enables the UAV to cover extensive areas for surveillance and reconnaissance without requiring proximity to the control station.
1.3	Flight Speed	The UAV system shall be capable of flying at speeds ranging from 50 km/h to 150 km/h.	Allows for flexible mission planning, whether for fast reconnaissance or slower, more detailed inspections.
1.4	Payload Capacity	The UAV system shall be capable of carrying a payload of up to 20 kg, including cameras and sensors.	Ensures sufficient capacity for carrying various mission equipment, enhancing the UAV's operational versatility.
1.5	Altitude Control	The UAV system shall be capable of operating at altitudes between 500 meters and 5,000 meters above ground level.	Provides operational flexibility to fly at different altitudes, improving mission success based on environmental and tactical needs.
2.1	Communication Range	The UAV system shall maintain reliable communication within its operational range.	Ensures that the UAV remains controllable and effective at all distances during its mission.
2.1.1	Line-of-Sight Communication	The UAV system shall maintain uninterrupted communication with the ground control station for distances up to 100 km in line-of-sight conditions.	Ensures operational efficiency in open areas, where obstacles do not interfere with signal transmission.
2.1.2	Non-Line-of-Sight Communication	The UAV system shall maintain communication with the ground control station at distances up to 50 km in non-line-of-sight conditions.	Provides operational flexibility in complex terrains, such as urban areas or forests, where line-of-sight may be blocked.
2.1.3	Signal Loss Handling	The UAV system shall automatically switch to a pre-programmed return-to-base mode if communication is lost for more than 30 seconds.	Ensures safe recovery of the UAV in case of communication failure, reducing the risk of mission failure.
2.2	Environmental Operating Conditions	The UAV system shall be capable of operating in a wide range of environmental conditions without performance degradation.	Ensures the UAV's mission effectiveness across various environmental conditions.
2.2.1	Temperature Tolerance	The UAV system shall operate in temperatures ranging from -20C to 50C without degradation in performance.	Ensures that the UAV can function in both cold and hot climates.
2.2.2	Wind Resistance	The UAV system shall be capable of operating in wind speeds up to 20 km/h.	Ensures stable flight and accurate positioning in windy conditions.
2.2.3	Humidity Resistance	The UAV system shall be capable of operating in humidity levels up to 95%.	Ensures reliable operation in high-humidity environments.
2.2.4	Dust and Sand Protection	The UAV system shall be capable of operating in dusty or sandy environments.	Ensures that the UAV's sensors and components are protected from particulate matter.
2.3	Camera and Sensor Performance	The UAV system shall be capable of capturing high-resolution images and video.	Enables detailed surveillance and reconnaissance capabilities.
2.3.1	Still Image Resolution	The UAV system shall be capable of capturing still images with a resolution of at least 1080p.	Enables clear identification of objects and terrain features.
2.3.2	Video Streaming Resolution	The UAV system shall be capable of streaming video at a resolution of at least 720p.	Enables real-time monitoring and decision-making.
2.3.3	Night Vision Capability	The UAV system shall be capable of operating in low-light conditions.	Enables surveillance and reconnaissance during nighttime operations.
2.3.4	Zoom Functionality	The UAV system shall be capable of zooming in and out of images.	Enables detailed inspection of specific areas of interest.
2.4	Flight Control	The UAV system shall be capable of autonomous flight and manual override.	Provides flexibility in mission execution and control.
2.4.1	Autonomous Navigation	The UAV system shall be capable of autonomous flight to a target location.	Enables efficient mission planning and execution.
2.4.2	Manual Override	The UAV system shall be capable of manual control by the operator.	Provides a fallback option for emergency situations.
2.4.3	Obstacle Avoidance During Flight	The UAV system shall be capable of detecting and avoiding obstacles.	Ensures safe flight in cluttered environments.
2.4.4	Landing Precision	The UAV system shall be capable of precision landing on a designated area.	Enables safe and accurate mission completion.
2.4.5	Takeoff and Landing in Adverse Conditions	The UAV system shall be capable of takeoff and landing in adverse weather conditions.	Ensures mission success in various environmental conditions.
2.4.6	Altitude Hold Mode	The UAV system shall be capable of maintaining a constant altitude.	Enables stable flight for extended periods.
3.1	Collision Avoidance	The UAV system shall be capable of detecting and avoiding other aircraft.	Ensures safe operation in shared airspace.
3.2	Emergency Landing	The UAV system shall be capable of emergency landing in case of a failure.	Minimizes the risk of damage and injury.
3.3	Battery Management	The UAV system shall be capable of monitoring battery levels and providing warnings.	Ensures sufficient power for mission completion.



# Demonstration

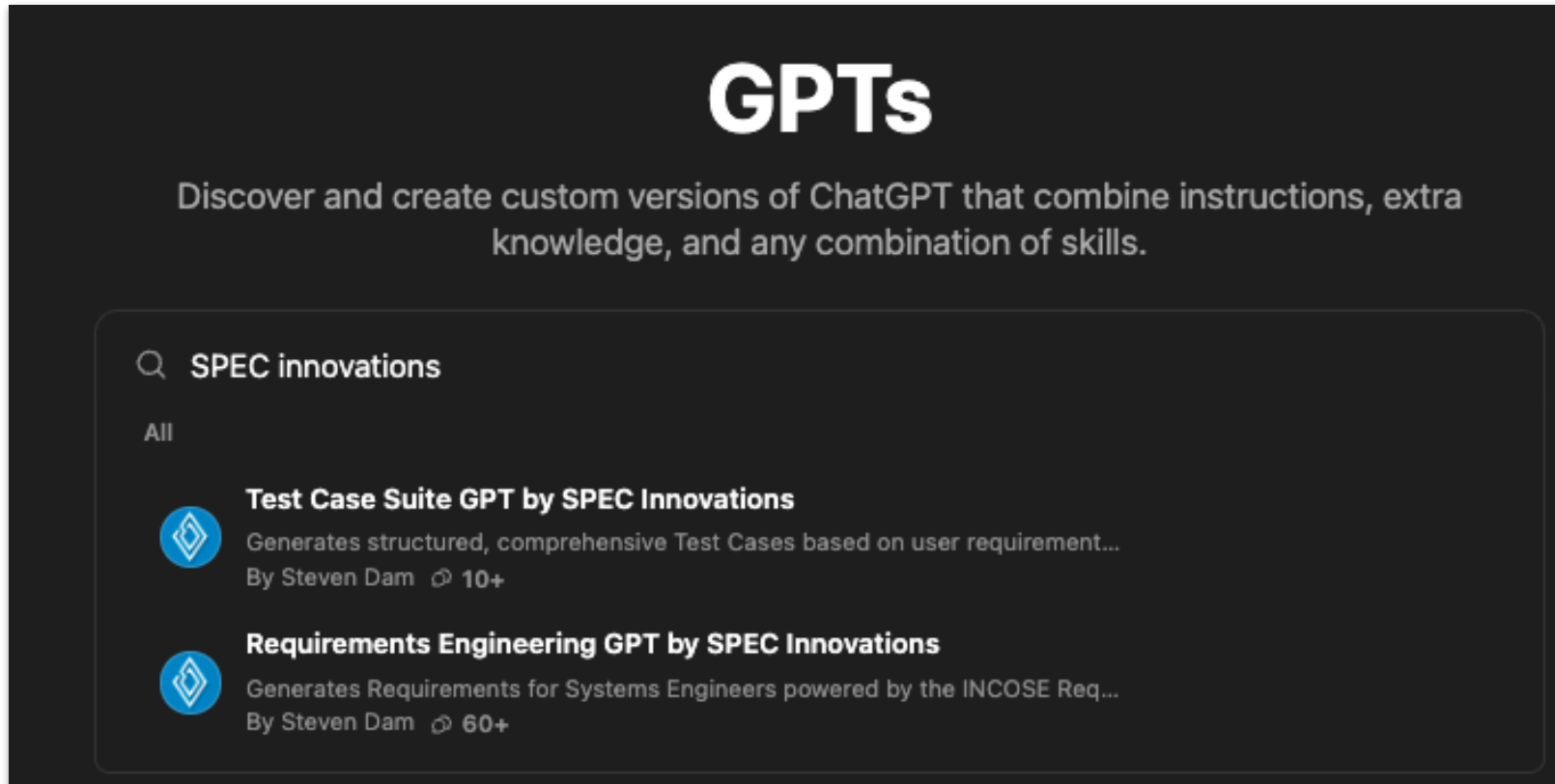
**NDIA**



# Lessons Learned

- AI is **NOT** perfect!
- Be Aware of the AI Assumptions & Context Windows
- Susceptible to mistakes, but with control can be a powerful assistant
- Great Starting Point for Content or Structure
- Consistency Checks is Essential
- Successful experiment in understanding what AI can/can't do
  - Inspired implementation on Innoslate now in development

# Try them out in GPT Store for Free!





**GPTs**

Discover and create custom versions of ChatGPT that combine instructions, extra knowledge, and any combination of skills.

Q SPEC innovations

All

-  **Test Case Suite GPT by SPEC Innovations**  
Generates structured, comprehensive Test Cases based on user requirement...  
By Steven Dam 🔗 10+
-  **Requirements Engineering GPT by SPEC Innovations**  
Generates Requirements for Systems Engineers powered by the INCOSE Req...  
By Steven Dam 🔗 60+

## Requirements Engineering GPT



## Test Case Generator GPT

