

# 24RM801 RESEARCH METHODOLOGY FOR ENGINEERING

Assignment 1:  
Research Question Development and Design

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## **Research Objective:**

### **Enhancing Explainable AI for Pilot-Assisted Decision-Making in Commercial Flight Decks**

## **Research question :**

**How can explainable AI (XAI) systems be designed and integrated into commercial aircraft flight decks to enhance pilot decision-making and situational awareness, while ensuring alignment with human operators' dynamic preferences and adherence to safety-critical standards?**

## **Few considerations :**

- **Moving beyond just predicting, to holistic **decision making**.**
- **Pilot should understand the AI driven suggestions, fostering trust and effective human-ai collaboration. Hence the focus on **explainable AI**.**
- ****Dynamic human preferences** - due to the changing weather and traffic conditions, the preferences and decision making strategies of pilot can evolve during a given flight.**
- **Ensuring that AI systems adhere to stringent **safety standards** is paramount in aviation**



# Questionnaire design

Theme	Questions
Understanding current challenges	<p>1. What are the key challenges pilots face in decision-making and maintaining situational awareness during flight operations in a modern automated flight deck of a commercial jet?</p> <p>2. What are the key explainable AI and AI alignment methods prevalent today, and what are the current gap &amp; challenges, in making them ready for application into flight deck operations?</p>
Perceptions of explainable AI	<p>3. What are the key use cases in pilot operations, where AI along with explainability needs implemented for an effective decision making aid for pilot.</p> <p>4. What types of explanations or feedback from an AI system would a commercial pilot find most useful during flight operations?</p>
Design considerations of explainable AI	<p>5. What features should an XAI system prioritize to align with a pilot's dynamic preferences during a flight?</p> <p>6. How and when should an AI system adapt its recommendations based on real-time changes in flight conditions or pilot preferences?</p> <p>7. What level of control should pilots have over customizing or overriding AI recommendations?</p>
Integration and safety standards	<p>8. What challenges do you anticipate in integrating XAI systems into existing flight deck automation?</p> <p>9. How important is regulatory oversight in ensuring the safety and reliability of AI systems in commercial aviation?</p>
Measuring Impact	<p>10. What specific outcomes would indicate that an XAI system has successfully enhanced pilot decision-making and situational awareness?</p>





# Unbiased research question formulation and design

Unbiased research question formulation and design are critical to ensuring valid, reliable, and generalizable research outcomes. In the context of investigating "How can explainable AI (XAI) systems be designed and integrated into commercial aircraft flight decks to enhance pilot decision-making and situational awareness," the importance of neutrality cannot be overstated. Bias in question formulation can lead to skewed responses, misinterpretation of data, and invalid conclusions, undermining the research's credibility and utility.

Unbiased questions create a neutral framework for respondents to share their perspectives without being influenced by the researcher's assumptions or expectations. For instance, leading questions like "Do you agree that XAI improves situational awareness?" might pressure respondents into providing affirmative responses. Conversely, neutral questions like "What are your thoughts on the role of XAI in situational awareness?" encourage respondents to share unbiased, authentic opinions.

In the current problem statement, questions are designed to avoid bias and ensure comprehensive data collection. For example, the use of a mix of open-ended questions (e.g., "What are the key challenges pilots face in decision-making and maintaining situational awareness during flight operations in a modern automated flight deck of a commercial jet?") and closed-ended questions (e.g., "What specific outcomes would indicate that an XAI system has successfully enhanced pilot decision-making and situational awareness?" Or "What are the key use cases in pilot operations, where AI along with explainability needs implemented for an effective decision making aid for pilot?") ensures both depth and structure. Logical organization—starting with general questions and progressing to specific ones—fosters engagement and minimizes order effects.

This careful design aligns with the principles of unbiased research, contributing to robust findings that accurately reflect the complexities of integrating XAI into flight decks while adhering to safety and human-centric requirements